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SMALLER EXPORT TRADE.

The total figures for the electrical export trade for the 12 months ending with June bear elequent testimony to the stagnation and depression in general industry that has existed since the panic of October and whose premonitory symptoms were to be noted earlier. Our electrical exports were increasing at an average rate of about $1,000,000 a year, but during 1907-8 they fell off more than that amount as compared with the corresponding period 1906-7. It appears that the total was $15,249,436 as compared with $17,268,406, showing a loss of $2,018,970 for both electrical appliances and heavy electrical machinery. This is a decline at the rate of 12 per cent, which is somewhat less than the average decline in business; but it indicates well enough the severity with which restrictive causes operated. An analysis of the returns shows that while the falling off in electrical instruments and appliances was $1,508,423, the decline in machinery was $510,547. These losses were made pretty freely all over the world, but were strongly marked in Europe, where they still continue. Germany, for example, has only bought from us during the last seven months $53,479 in electrical instruments, while her purchases in the same period of 1907 ran to $227,999.

These are notable changes, and the question arises whether anything can be done to meet them. Possibly an answer may be found in a study of the conditions. It is certain that there has been a falling off in international trade during the past year, with a lower scale of prices. Any betterment in this respect, and some is now occurring, must benefit electrical business, and, we think, lead to larger shipments at better prices. Another active cause of decline would seem to lie in the fact that as usual when swamped with domestic orders, our manufacturers have been inclined to neglect foreign trade, with the result that it has now to be worked up again. We have to meet cheaper producers than ourselves in the common markets of the world, and it needs many qualities of merit to offset a lower price.

At the present moment our electrical export trade, like other branches, is under menace of diminution by the new English patent law requiring an invention to be made and worked in the United Kingdom. One authority has estimated that this means an addition of $125,000,000 to the manufacturing capital of England, with larger employment of local labor. There must be felt some harm from this "sumptuary" legislation, but it is obvious that retaliatory measures will at once be provoked, and we may be sure that the approaching session of Congress will see laws passed compelling English patentees to make their goods in this country or lose their patents. It is only another of those cases to which applies the adage that it is a poor rule which doesn't work both ways. Meantime, a large quantity of goods are not subject to this legislation, and we can only urge American manufacturers to reach out with great

energy, insistance and courage for the neutral markets of the world. Moreover, in reaching out, some of them might possibly derive benefit from reading the complaints filed with and reported by American consuls as to unpunctuality in delivery, bad packing, departure from conditions of purchase, inattention to foreign laws or regulations, variation from grade and other shortcomings. As illustrative of what we have in mind, we may mention the fact that not many years ago one of the editors of this journal received urgent cable messages from abroad asking him to be so kind as to look up certain repeated orders that had been sent for a quite large quantity of electrical apparatus, to a concern seeking foreign trade, and that had remained utterly unacknowledged in any respect!

Acyclic Generators.

The article by Mr. J. E. Noeggerath on page 574 of this number shows the progress that has recently been made by the acyclic—or formerly named, unipolar—generator in this country. It is curious to notice that Faraday's first type of dynamo device was acyclic. Acyclic machines were also early constructed for low voltages, but for central-station voltages this type of dynamo was given up as hopeless until the advent of the steam-turbine, which with its large sizes and high speeds opened the door of possibility. One of the few objections to the application of the steam turbine to central-station practice has been that turbines were not adapted to drive direct-current generators, owing to high speeds and commutation difficulties. It has been Hobson's choice to use alternating-current generators on steam turbines. Here the acyclic generator comes to the rescue by offering a direct-current machine without commutation and with very small armature reaction. There are some interesting peculiarities about acyclic machines that present sharp contrast with cyclic machines. They are the only machines which generate continuous currents fundamentally. All of the ordinary direct-current machines generate alternating currents in their windings, and merely rectify these currents for exportation. It is only outside their commutators that they are direct-current machines. Inside, they are alternators. For the same reason acyclic machines are the only ones which are capable of keeping silence in a telephone connected to their terminals. The ordinary direct-current generator gives a loud commutation note. Again, a machine with two, three, four or six collector rings is almost inevitably an alternator, but a machine with 20 or more collector rings is naturally of the acyclic type. In fact, taking the outer surface of the rotor into consideration we may say that these new acyclic machines are more than half collector rings.

A salient difficulty in the design and construction of acyclic generators is the brush-contact difficulty, and the generators described in the article are no exception to the rule. We have only to remember that the peripheral speed mentioned of the collector rings is nearly 300 miles or 450 km per hour to realize the difficulty of maintaining good brush contacts at perhaps 100 brushes touching such rings, without excessive friction, heat and wear. To keep these friction losses moderate while maintaining effective service at all times is the great problem in such machines. It is interesting to notice that these acyclic generators have no windings worth mentioning to an armature winder. In the cases described, the armature conductors are copper rods placed in tunnels beneath the surface of the smooth unlaminated armature core. These rods develop, however, a working voltage of about one volt per linear centimeter, owing to the high speed at which they travel. Moreover, as described, soldered joints are even considered undesirable, and the contact pressure of centrifugal force is considered sufficient to maintain good operative connection. There is certainly some comfort in knowing that no matter how hot the copper parts become it is impossible for them to throw out molten solder.

An advantage possessed by such acyclic generators is that they admit of supplying not merely two equal voltages to three-wire systems with the aid of a central tap, but also that they can readily supply three or four graded voltages to multiple wire systems in factories for operating motors at different speeds without armature rheostats. Hitherto we have had no counterpart in direct-current machinery for the autotransformer in alternating-current machinery. The nearest approximation has been the direct-current dynamotor. The acyclic machines described in the article, however, are complete direct-current analogues of autotransformers, taking in power as motors at full line voltage, and giving out this power as generators, after deducting losses, at lower pressure but correspondingly greater current from a part of the same actively-rotating conductor. We hope to see this type of acyclic generator come into extended use in direct-current central station service. It cannot be denied that such a machine in a turbo-generator affords a rotor of ideally simple construction. In the turbine element it consists merely of a number of solid wheels with bucketed peripheries to receive the impact of the steam. In the generator element it consists merely of a cylinder of cast steel carrying a bundle of copper rods in tunnels beneath its surface, terminating in collector rings. This simplicity nearly spells finality.

Improvements in Magnetic Core Material.

Although there are many factors to be taken into consideration when specifying the permissible output from a stationary transformer, yet the fact remains that the real determining element is the allowable maximum temperature or, as generally—though not so correctly—stated, the maximum temperature rise. Thus, the character of constructive material used in the past has rendered it desirable that a temperature of 75 deg. C. be not exceeded or that the rise be not greater than 50 deg. C. above an arbitrarily assumed room temperature of 25 deg. C. These limits have been set, partly on account of the slow destruction of the insulation, but more largely by reason of the "aging" of the core material at high temperature. The "aging" effect is cumulative. The high temperature causes an increase in the core loss, which not only lowers the efficiency, but increases the temperature and thereby augments the rate of increase of the core loss and the temperature rise. An article by Mr. T. S. Allen in this issue reports the results of some tests on core material, containing among its so-called "impurities" about 3 per cent of silicon, which is practically free from any "aging" whatsoever. It would seem that when material of this nature is used, the allowable maximum temperature might well be placed at a value much above 75 deg. C. without affecting the useful life of the transformer. Moreover, it might prove more economical to operate at a higher temperature and thereby

obtain low-priced transformers to be replaced at certain intervals, rather than to pay the interest on high-priced long-lived transformers.

A feature of the newer transformer core material no less valuable than its non-aging characteristic, is its low energy dissipation when subjected to magnetic reversals. The tests reported in this issue indicate that if the silicon-steel alloy were substituted directly for an equal amount of standard annealed steel in a certain transformer, the core loss would be reduced by about 40 per cent. However, a substitution of this nature would result in a transformer having an improper balance between the losses in its coils and core and subjected to unequal temperature rises throughout the transformer structure. It would be far preferable to maintain the former losses by increasing the magnetic density. Such a result can be secured by increasing the impressed voltage by about one-third. By the latter method there would be obtained a transformer having a rating, based upon the former temperature rise, one-third greater than before, the losses now being 25 per cent less in comparison with the full-load output. The improvement resulting from the above substitution is not quite so great as might be inferred, because the resulting transformer must now be compared with a standard transformer of the larger rating which is more efficient and relatively lighter per unit output than a smaller transformer; the weight and losses being probably 6 per cent less per kilowatt of rating, the net improvement in decrease in losses would be, say, 19 per cent instead of 25 per cent.

It is worthy of note that, although the permeability of the silicon-steel alloy does not differ greatly from that of annealed transformer steel throughout certain ranges of magnetic density, yet the value of exciting volt-amperes of a transformer using the alloy is much greater than of the older transformers. If in certain 60-cycle transformers the core loss is one watt per pound, the exciting current will be four times as great with the silicon-steel core as with the annealed steel core, and it will bear this same increased ratio to the full-load current. Moreover, on account of the increase in the output of the improved transformer, this value of exciting current must be compared with that of an older transformer of equally increased output, which is about 6 per cent smaller. Thus the value of the no-load wattless volt-amperes of a certain transformer having a silicon-steel core will be about 325 per cent larger than that of an older transformer of equal rating, while the power component of the no-load current will be about 19 per cent smaller. That is to say, the no-load current of the improved transformers will be much greater, and the no-load power factor much less, than that of older transformers. This feature, which considered alone is not an advantageous one, is of no practical importance because the power factor at full non-inductive load would be very high even in the case of the silicon-steel core. The remarks concerning the relative unimportance of the reluctivity of the new magnetic material are applicable to transformer cores, but the conclusions would be different when dealing with field magnet cores. For the construction of field cores, there exists at present an urgent demand for a material having good mechanical strength and low magnetic reluctivity at high density, the resistivity and hysteretic properties being of no great importance. It is probable that such a material can be produced by combining with steel in the correct proportion some "impurity" other than silicon. It is to be hoped that the investigations relating to the magnetic properties of steel alloys will be continued until the effects of all "impurities" are known, and an alloy of high permeability especially well suited for revolving-field cores has been produced.

THE SENSITIVENESS OF SELENIUM CELLS.

The property of selenium to increase its electrical conductivity under the incidence of light was accidentally discovered some decades ago. Selenium has a very high resistivity of somewhat definite character. A short prism of this substance was being experimented with as a permanent very high resistance, when the conductance was found to vary very plainly with the intensity of illumination on the prism. Numerous attempts have been made to utilize this property, but none seems to have remained in practical service. In the first place, the increase in conductivity is far from being proportional to the intensity of the illumination received. In the second place, the effect, although it may commence instantly, is by no means prompt, but gradually advances toward a maximum. In the third place, there is a hysteretic effect depending upon previous illumination history. So variable, in fact, has the behavior of selenium cells been, in general, that no formula or quantitative relation has hitherto been published connecting conductivity change with illumination, so far as we are aware. As noted in the Digest, the Royal Society Proceedings have recently published a paper, by Prof. G. M. Minchin, on a new construction of sensitive selenium cell, for whose behavior a formula is offered. The advantage of the construction appears to be in the very short gap between electrodes occupied by the selenium layer, consistent with considerable mechanical rigidity. The relative degree of increased sensibility thereby obtained is not disclosed in the paper.

The most interesting feature of the cell outside of its mode of construction is the empirical formula that is stated to fit its behavior. It appears that blue light is distinctly more active than red light, as indeed is not surprising, considering the greater chemical activity and higher frequency of light at the blue end of the spectrum. It also appears that with red light, if a certain incident illumination should double the initial conductivity of the cell—that is, increase it by 100 per cent—then doubling the illumination would only add about 30 per cent more to the conductivity. With blue light, under similar conditions, doubling the illumination would increase the conductivity about 43 per cent, or from 200 to 243. Considering the powerful influence which incident illumination must produce in transparent substances, it is wonderful that more substances have not been discovered which respond in conductivity to illumination. One reason may be that, setting aside electrolytes, transparent substances are essentially non-conductors, and conductors are essentially opaque, so that any effect capable of being produced at a depth below the surface in transparent bodies is prevented from exhibiting itself, by reason of non-conduction. On the other hand, bodies which, like metals, conduct, and might have that conduction altered by illumination, limit the effect to a superficial layer owing to opacity, and even at the surface the secondary thermal effect perhaps overshadows the effect due to illumination directly. It is a significant circumstance that selenium is a substance on the dividing line between conductors and non-conductors.

New Home for the British Electrical Engineers.

The last issue of the *Transactions* of the Institution of Electrical Engineers brings a full report of the annual meeting of June 30, when after considerable but chiefly favorable discussion, it was unanimously resolved to secure the building on the Victoria Embankment known as the Medical Examination Hall from the Royal College of Physicians and the Royal College of Surgeons, and make it the home of the institution. The sum required is $50,000, and a further sum of $30,000 is estimated as necessary for changes. At the meeting, Mr. Robert Hammond put the assets of the institution at about $211,300, leaving a loan to be raised of $80,000. The income of the society for 1909 is put at $65,000. The property is taken on a lease which has 76 years to run, and against which an annual sum of $1,000 will be set off for amortization. The accompanying view is from a photograph (Fig. 2). It will be seen that the building is handsome and commodious. For some time to come the institution will not require all of it, but will be able to house a few kindred societies, after the manner of the United Engineering Building.

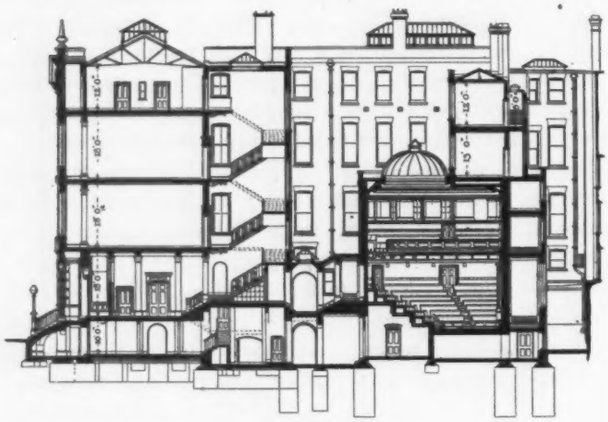


FIG. 1.—SECTIONAL VIEW OF BUILDING.

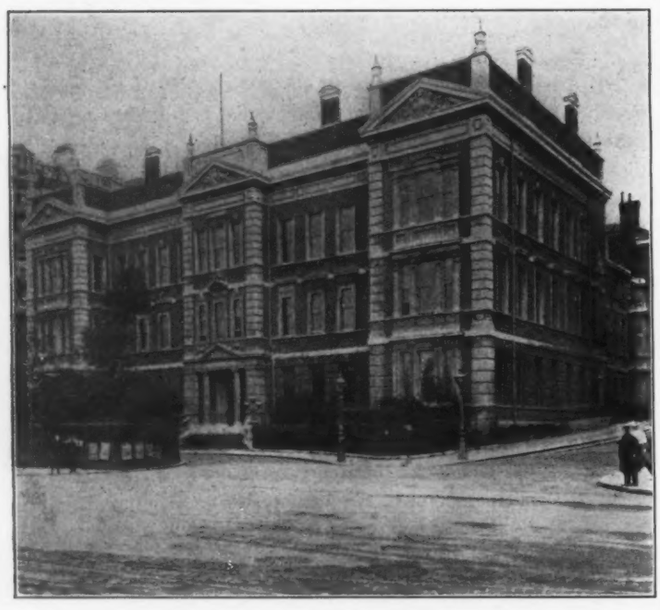
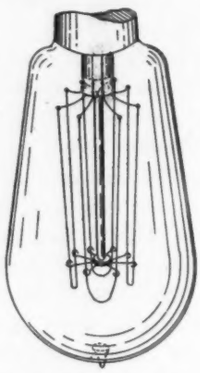


FIG. 2.—VIEW OF BUILDING FROM VICTORIA EMBANKMENT.

At the meeting, the plan was warmly supported by Mr. George G. Ward, the honorary secretary and treasurer for the United States, and Mr. E. C. Barton, the local secretary for Brisbane, Queensland. Speeches on behalf of the plan were also made by Messrs. Mordey, Alexander Siemens and Sir Joseph Swan, while the leading opponents were Major P. Cardew and W. B. Esson. The institution now has about 6000 members.

Kuzel Tungsten Lamp.

A United States patent issued Aug. 25 to Hans Kuzel and Richard Hoke, of Vienna, Austria, relates to means for supporting the metallic filament of an incandescent lamp. The invention is stated to be based on the discovery that the deformations of the filaments of such lamps may be avoided or reduced to a minimum by so arranging the points of connection of the filament to the leading-in wires and holding devices that the weight of the filament counteracts the distorting or deforming effect when it is heated. This result is obtained by so arranging the points of attachment of the metallic filament to the leading-in wires relatively to the hooks or holding devices, that in a hanging lamp the former are not in vertical lines above the center of the latter, as heretofore; the radial distance between the points of attachment from the longitudinal axis of the lamp being different from the radial distance of the centers of the holding devices from such axis. For securing the desired result it is necessary that each leg of each filament be provided with a holding device, such as an eyelet or hook, as shown in the illustration.



KUZEL TUNGSTEN LAMP.

Electrical Development in Turkey.

It will be interesting to see whether the recent political and constitutional changes in Turkey have a helpful effect on the development of the country industrially, and the stimulation of engineering enterprises. United States Consul-General Edward H. Ozmun, writing from Constantinople, tells of opportunities presented to American financial and electrical machinery interests in Turkey. He says:

In the annual report of this office for the year 1907 attention was called to the necessity of the establishment of an American bank in Constantinople with a view of interesting American capital in concessions granted by the Turkish government for important industrial undertakings, such as railways, mines, electric traction and lighting, and harbor works, all of which would eventually be a natural medium for introducing American plants and machinery. With this object in view, the attention of capitalists is invited to the following two projects, and this office will be pleased to put interested parties or syndicates in touch with an intermediary from whom they could obtain information in regard to the conditions of these concessions.

The firman, convention and "cahier de charges" for this scheme cover also telephone and motor-car service and the monopoly for the sale of electric appliances for installations of electric lighting, etc., in private houses. This matter has been thoroughly examined by a Belgian engineer for account of a Belgian group of capitalists who were willing to take up the concession, but could not come to terms on the remuneration to be given. The terms of the convention and cahier de charges

are considered to be perfect, and all documents, including plan and engineer's report, are at the disposal of anyone wishing to study the same.

The city of Aleppo has an estimated population of 197,000 inhabitants. It is the center of transit of certain exports from Asia Minor, Mesopotamia, Arabia and Persia, and is in a rich mineral district. There are copper mines, coal and green marble quarries in the neighborhood of the city. The whole province is very fertile, and with the completion of the present railway system, which is the most important work which has been undertaken for years, a large market will be opened for European produce and will contribute very largely to the export trade.

The Broussa concession covers the right to use water power in carrying out the enterprise. The convention and cahier de charges are said to contain certain articles which would not be acceptable to any group, but the concessionnaire could have these modified. The city of Broussa is situated at the foot of Mount Olympus to the north, was the ancient capital of Turkey, and is the seat of a governor-general. It has an estimated population of 120,000, and is noted for its iron and sulphur baths, which are much patronized and are a source of attraction from the whole empire.

Ornamental Street-Lighting Posts in Boston.

The Edison Electric Illuminating Company of Boston is planning to bring the ornamental type of pole design used in Vienna to the consideration of the Boston authorities this fall for use in park lighting. These poles are of bronze, as used abroad, and are provided with special urns at the bottom and near the middle for the bedding of growing flowers. Their effect is extremely pleasing to the eye, and the company has placed models of this construction in its offices for examination by interested visitors.

Oil Fuel in Rochester Power Plant.

With regard to the proposed plan of using oil as fuel in the power plant of the Rochester (N. Y.) Railway & Light Company, Mr. R. M. Searle, the general manager, sends us this interesting data: "We are equipping one boiler with a deep furnace to burn coal at the proper rate of combustion per square foot of grate, and have arranged to sell in the neighborhood to manufacturers in close proximity to our steam standby plant about all the steam this boiler would generate, less that needed to keep our steam standby auxiliaries and a 3000-kw turbine floating with one nozzle in use, and using the water from our hydro-electric system to maintain a constant vacuum on the turbine so that when floating it is at its highest efficiency as a steam standby.

"The plan is to use the three standby boilers connected with the steam header to maintain high temperature in the steam drums and steam pressure of the two boilers standing idle with no fire under them. The steam standby consists of three boilers, and the products of combustion of the boiler using coal passes through it down through the second boiler and up through the third. The object of this is to keep the tubes full of hot water circulating rapidly so that the moment additional steam is required the oil burners under these two boilers will be ignited, and steam will be generated instantly because of the two being maintained at a high temperature. The oil burners will be used for temporary interruptions and for peaks up to and including three hours.

"In maintaining the two boilers 'hot, ready to serve' we found that this plan could only be accomplished economically by the use of a McLean balance draft system, as in order to get the highest efficiency there could not be any vacuum on the settings of the boilers, and with the McLean system we are able to maintain an atmospheric balance with the three boilers, which works out a saving of about 30 per cent in this particular instance.

"The plan as outlined is a very comprehensive one, and so interesting that it will probably be the subject of a paper at one of our electrical associations."

Death of Mascart.

Prof. E. E. N. Mascart died at Paris last week at the age of 71. Several years ago Prof. Mascart retired from active work of the College de France and the Central Meteorological Bureau, and for some time had been in ill health.

Prof. Mascart after graduating from the College of Valenciennes at the age of 19, became tutor at the Lycées of Lille and Douai. In 1858 he entered the Ecole Normale Superieure where, after completing his course, he remained until 1864 as assistant on the teaching staff. Following the usual course of the graduates of this great school, he first filled chairs of physics in the provinces—at Metz and Versailles—and in 1868 was called to Paris to take the position at the College of France of adjunct professor to the celebrated Regnault and on the decease of the latter he succeeded to the full professorship. During the Franco-Prussian war Mascart served as assistant director of the cartridge and arms factory at Bayonne. In 1878 he was appointed director of the Central Meteorological Bureau of France, which position he held until recently.

Mascart was the author of four monumental works. In 1878 he published his "Treatise on Static Electricity" in two volumes. Between 1882 and 1886 his well-known work entitled

E. E. N. MASCART.

"Lessons in Electricity and Magnetism" appeared with Prof. Joubert as collaborator; the work of the latter, however, was principally the preparation in systematic form for publication of the lectures delivered by Professor Mascart at the College de France. About 1892 his "Treatise on Optics" in three volumes appeared. Finally, in 1900 he published his "Treatise on Terrestrial Magnetism." The characteristics of these great contributions to physical science are comprehensiveness of scope, a remarkable lucidity of style and condensation in treatment which enables a subject usually requiring pages of elucidation to be disposed of without sacrifice in a few short paragraphs.

During the greater part of his life Mascart was one of the most active figures in the scientific circles of Paris. He was a member of the Academy of Sciences, and served as president of the Physical Society, the International Society of Electricians, the Meteorological Society and the Association for the Advancement of Science. He also served as president of the Committee on Commerce and Manufactures, attached to the French Ministry of Commerce, and as president of the Commission of Inventions for the Army and Navy. He took a leading part in the several international electrical congresses held in Paris, namely those of 1881, 1889 and 1900, and was a delegate of the French Government to the International Electrical Congress of Chicago in 1893. For many years few nominations of representatives of physical science to the Legion of Honor were made without prior consulation with Mascart, who was a grand commander of that body. A servant by education and by inclination, Mascart nevertheless kept in close touch with the practical applications of physical science and had a large acquaintance among engineers and other representatives of the electrical art. Of a kindly and sympathetic disposition, and with the gift of inspiring those who came under his influence,

whether as associates in scientific bodies or as students at the College de France, for a generation he dominated the heart and mind of scientific Paris, where his loss will be most grievously felt.

The Discovery of Magnetic Dip.

By Brother Potamian, Sc.D., Lond.
Professor of Physics in Manhattan College, New York.

The opinion has been ventured that the first reference in print to magnetic dip is contained in a very rare book of 67 pages on astronomical, physical and religious subjects by Fortunio Affaitato (or Fortunius Affaytatus), which book was dedicated to Pope Paul III and printed in Venice in 1549.

The table of contents has two entries relating to magnetic matter, the first on "The peculiar descent of the magnet to the pole, or if you prefer it, the turning of the magnet itself to the pole"; and the second on "The causes why the magnet attracts iron."

The fifth chapter, beginning on page 9, is the one which contains the supposed allusion to the dip of the needle. It is entitled "The twofold effect of weight on the magnet and why the magnet turns to the pole." The words of the author are:

"De Duplici In Magnete Gravitatis Effectu Et Cur Ipse Magnes Ad Polum Vertatur.

"Prius tamen animadvertendum duplicem in magnete gravitatis effectum. Alter est, qui per longitudinem centrum petit, ut circularem coeli motum declinet, quemadmodum et terra, itaque nullo obstante impedimento deorsum fertur. Alter est qui per latitudinem, ad polum vertitur, eadem scilicet ratione, ut et motus coeli circularis impetum fugiat, ubi videlicet per vim aliquam, veluti per suspensionem negatur ad centrum descensus, tunc enim vi quadam, non alia tamen quam gravitatis, vivaciori tamen quam terrae, magnes ipse, quantum fieri potest, motus coeli violentiam fugit, quod, quia nulla via facilius assequi potest, quam ut fiat veluti axis et polum spectet, axis fit et polum spectat, atque ita constitutus, nulla aut modica coeli vi torquaetur, quam procul dubio et supra modum sentiret, nisi ad eum modum poneretur: et quasi a motu coeli, hoc sibi peculiari gravitatis effectu descenderet. Vehemens enim vis motus coeli in ea parte coeli regnat, quae maxime, a polis distat, ea vero quae magis ipsis est propinqua, minori quoque violentia motus particeps efficitur, ita ut poli penitus immobiles sint, mirum igitur esse non debet si magnes quodam ad eos (sua quidem vivida gravitate) descensu convertatur."

Following is an attempt at turning the above chapter into the vernacular, the word "inertia" being put in by way of query by the translator; weight in the author's philosophy probably meant a mode of inertia peculiar to the lodestone and the compass needle arising from their magnetic condition.

On the twofold effect of weight (inertia?) on the magnet and why the magnet turns to the pole.

Two effects of weight (inertia?) have to be noticed: one is that the magnet tends lengthwise to the center of the earth in order to avoid the effect of the circular motion of the heavens, after the manner of the earth itself; so that when there is nothing to prevent it, the magnet is borne downward. The second effect is that the magnet points to the pole according to the latitude of the place manifestly for the same reason, that it may escape the influence of the motion of the heavens; and it will point to the pole unless prevented by some force such, for instance, as may arise from the manner in which it is suspended. Even then with a certain force similar to weight (inertia?) but more vigorous than the pull of the earth, the magnet tries to free itself from the influence of the rotation of the heavens as much as it can. As there is no easier way than by assuming an axial position and pointing to the pole, it becomes an axis and looks poleward. In this position, it is acted upon by no force of the heavens or by very little. Without doubt, it would experience some force did it not point that way. Fleeing then the rotation of the heavens, the magnet turns to the pole by this effect of weight (inertia?) peculiar to itself. But as the force due to the motion of the heavens is greater in those parts of the celestial sphere which are farthest away from its poles and less in those which are near; and as, moreover, the poles are absolutely immovable, one should not wonder then if the magnet in settling down to rest should always point to them in virtue of this peculiar effect of its weight (inertia?).

Of the two effects described in the above chapter, both have been considered by some writers to refer to the dip of the magnetic needle, the phraseology used lending some color to the view, chiefly the verbs *declinare* and *descendere,* which occur often in this and other chapters in various moods and tenses, also the phrase *deorsum fertur* (is borne downward).

Gilbert (1544-1603), who was acquainted with this little treatise of the Italian philosopher, did not admire it at all because it contains "some silly philosophizing about the attraction of iron and the turning of the needle to the pole." Somewhat similar is the judgment of Padre Bertelli (1826-1905), who refers to the same booklet in his "Memoria Seconda Sulla Epistola di Pietro Peregrino," where he says on page 115 that this chapter of Affaitato contains nothing that may be construed as a direct reference to magnetic dip. Dr. Park Benjamin expresses the same opinion in his "Intellectual Rise in Electricity," page 211.

As for ourselves, we have given thought to this remarkable chapter of early magnetic philosophy with the result that in the

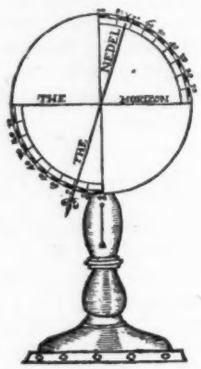


FIG. 1.—DIP-CIRCLE INVENTED BY NORMAN, 1576.

pointing of the needle to the pole "according to the latitude of the place," we are inclined to think that magnetic dip was meant. The author distinctly says that the needle points not to "the star," but to the pole of the world; consequently in latitude 30 deg. (say) as the polar axis makes an angle of 30 deg. with the horizon, a dipping-needle would take up a parallel direction, one end pointing upward to the pole of the heavens and the other downward to the center of the earth. This seems to follow from the expressions used, "per longitudinem *centrum petit*" and at the same time "per latitudinem *ad polum vertit.*" Further on, we shall see that Gilbert proposed a method of finding the latitude of a place from its magnetic dip.

If, in reading the above translation, we keep the dipping-needle in mind, the text becomes somewhat intelligible; if not, then we have to make the best we can of an obscure chapter of very occult philosophy.

The object of printing the Latin text as above is to invite correspondence and criticism, and thereby lead, if possible, to a clear apprehension of the author's statements concerning the behavior of the suspended magnet.

Affaitato was born in Cremona (date unknown) and drowned in the Thames while on a visit to London about the year 1550. He is described on the title-page of his little book as a theologian, natural philosopher and astronomer. The book is entitled "Physicæ ac Astronomiscæ Considerationes" and treats chiefly of eclipses and the magnet.

Five years before the publication of this work, that is, in the

year 1544, the tendency of a horizontal needle to dip was recognized by Georg Hartmann, vicar of the Church of St. Sebald, in Nuremberg. Having carefully balanced a steel needle, he noticed that after magnetization it did not remain horizontal, the north-seeking end dipping down through an angle of 9 deg. Hartmann consigned this important observation in a letter which he wrote in March, 1544, to Duke Albert of Prussia and which was published only in the year 1831.

The first unequivocal description of magnetic dip in print is that of Robert Norman, an instrument maker of Limehouse, London. The discovery was made by him in 1576 and described and aptly illustrated in his *Newe Attractive* which appeared in 1581. At first Norman experimented with compass-needles, but soon recognized that the magnet should not be pivoted, but swung on a horizontal axis so as to be free to move in a vertical plane. He further noticed that to get the full effect, the plane of the dip-circle which he invented should be placed in the magnetic meridian, an observation which shows a clear apprehension of the phenomenon of magnetic dip. The illustration which he gives in his little treatise, and which is here reproduced, shows that in 1576 the dip was 71 deg. 50′ in London.

Had Hartmann used Norman's mode of suspension, he would have got probably 60 deg. instead of the 9 deg. which he records.

It was easy for Gilbert to write down the "silly philosophizing" of Affaitato after he had developed with great pains and at

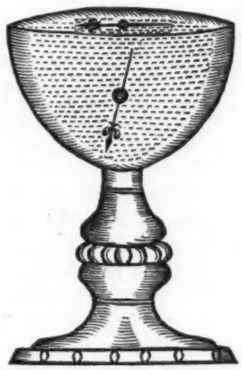


FIG. 2.—ILLUSTRATION OF MAGNETIC DIP (NORMAN, 1576).

great length and with great expense, too (which he could afford, being a wealthy bachelor), his grand theory which makes the earth a colossal magnet. The orientation of the compass was robbed of all mystery on this theory, particularly as Gilbert taught that the magnetic poles of the earth are diametrically opposite each other and that they coincide with the poles of rotation, whence it followed at once that the magnetic meridian coincides with the geographical and that the magnet, unless influenced by local attraction, would stand everywhere true to the pole.

It was, however, well known from the thrilling experience of Columbus and the constant reports of travelers that this was not generally the case. Gilbert himself says that at the time of writing *De Magnete,* Book IV, chapter VII, the needle pointed 11 1/3 deg. east of north in London. But what he did not know was that this easterly deviation was decreasing from year to year to vanish altogether in 1657, that is, 57 years after the publication of his monumental treatise on the magnet.

This magnetic declination sorely perplexed Gilbert, the thinker, just as the normal orientation preoccupied the philosophic mind of Affaitato. It did not fit in with theory, yet it could not be ignored; an explanation was needed and had to be forthcoming to uphold the plausibility of the "new and unheard-of" theory of terrestrial magnetism propounded by the philosopher of Colchester. As it was only proper to consider the earth a regular and well-behaved lodestone, though of cosmical size, Gilbert meets the difficulty brilliantly and in full tilt by saying that this variation is nothing else than a "perturbation of the directive force" caused by inequalities in the earth's surface, by continents and mountain masses. "Since the earth's surface is diversified by elevations of land and depths of sea, by great continental areas, oceans and seas differing in every way, while the power that produces all magnetic movements comes from the constant magnetic earth-substance, which is strongest in the most massive continents and not where the surface is water, or fluid, or unsettled, it follows that toward a massive body of land or continent rising to some height in any meridian, there is a measurable magnetic leaning from the true pole toward the east or the west."

This displacement has no connection with the gravitational pull of hills and mountains established later; it is clearly and essentially a magnetic action due to the lodestone nature of the disturbing masses. So convinced is Gilbert of the true and satisfactory character of his explanation that he goes on to say that "In northern regions, the compass varies because of the northern eminences, in southern regions because of southern eminences. On the equator, if the eminences on both sides were equal, there would be no variation." He does not hesitate to affirm a little further on that "in the heart of great continents, there is no variation; so, too, in the midst of great seas."

As continents and mountain chains are among the more permanent features of our planet, Gilbert necessarily concluded that this misdirection of the needle was likewise constant at any given place. "As the needle," he writes, "hath ever inclined toward the east or toward the west, so even now does the arc of variation continue to be the same in whatever place or region, be it sea or continent; so, too, will it be forever unchanging."

This we know to be untrue, and Gilbert, too, could have known as much had he brought the experimental method, which he used with such consummate skill and fruitful results in other departments of his favorite studies, to bear on this particular element of terrestrial magnetism. He labored with incredible ardor and persistence for 20 years in his workshops at Colchester over the experiments in electricity, magnetism and terrestrial magnetism which he embodies and discusses in his original and epoch-making book, *De Magnete,* published in the year 1600; a period of 20 years was long enough for such a careful observer as he was to detect the slow change in magnetic declination discovered by his friend Gellibrand in 1634, published by him in 1635, and known to-day as the "secular variation." It is true the quantity to be measured was small; but what is surprising is that such an industrious and resourceful experimenter as Gilbert was does not record anywhere in his pages observations of his own on declination or dip, elements of primary importance in magnetic theory.

Shortly after the voyage of Columbus it was thought that the *longitude* of a place could be found from its magnetic declination. Gilbert, however, did not think so, and accordingly scores those who championed that view. "Porta," he says, "is deluded by a vain hope and a baseless theory;" Livius Sanutus "sorely tortures himself and his readers with like vanities;" and even the researches of Stevin, the great Flemish mathematician, on the cause of variation in the southern regions of the earth are "utterly vain and absurd."

With regard to dip, Gilbert erroneously held that for any given latitude it had a constant value. He was so charmed with this constancy that he proposed it as a means of determining *latitude.* There is no diffidence in his mind anent the matter; he is sure that with his "inclinatorium" or dip-circle, together with accompanying tables, calculated for him by Briggs, of Gresham College, London, whose name is inseparably associated with the history of logarithms, an observer can find his latitude "in any part of the world without the aid of the sun, planets or fixed stars in foggy weather as well as in darkness."

After such a statement, it is no wonder that he waxes warm over the capabilities of his instrument and allows himself to exclaim: "We can see how far from idle is magnetic philosophy; on the contrary, how delightful it is, how beneficial, how divine! Seamen tossed by the waves and vexed with incessant storms while they cannot learn even from the heavenly luminaries aught as to where on earth they are, may with the greatest ease gain

comfort from an insignificant instrument and ascertain the latitude of the place where they happen to be."

The quotations given above are taken from Mr. P. F. Mottelay's translation of Gilbert's *De Magnete*, which was published by John Wiley & Sons, New York, 1893. Another translation was made by the Gilbert Club of London and published in the tercentenary year, 1900, with copious notes by Prof. S. P. Thompson.

Boston Y. M. C. A. School of Practical Electricity.

The fifth year of the school of practical electricity maintained by the Boston Young Men's Christian Association will open Monday, Oct. 5. Two courses are given in the school, one of which extends over 15 weeks and requires the student's attendance for 2¼ hours, three evenings in the week. This course is intended for men who wish to obtain as much of a working knowledge of electricity as they can in a brief period.

The second course offered is three years in length, and is intended for men who wish to acquire as complete a knowledge of electricity as may be possible, but are not prepared to attend a regular technical school. The conduct of the school is in charge of Mr. William Lincoln Smith, a graduate of the Massachusetts Institute of Technology, and municipal electrical inspector of Concord, Mass., and two assistants. The practical instruction is given by Mr. Fred G. Hartwell, who is superintendent of electrical construction work in the Massachusetts Institute of Technology. Mr. G. A. Rodenbaeck, who has been for several years instructor in the institute and is now with the firm of D. C. & William B. Jackson, gives the larger part of instruction in alternating-current work. Quite a creditable laboratory equipment has already been gathered, many donations of apparatus, etc., having been received from the electrical companies and supply houses in and about Boston and purchases made from time to time from the funds of the association.

Public Service Hearing on New York City Central Station Rates.

The investigation by the Public Service Commission of the First District of New York into the charges made by the various electric companies for current in New York City, was continued at a hearing by Commissioner Milo R. Maltbie, Sept. 3. Mr. W. W. Freeman, general manager of the Edison Electric Illuminating Company, of Brooklyn, was again examined as to the various forms of wholesale contracts made by his company. Forms were placed in evidence showing that the price to consumers varied from 12 cents per kw-hour to 5 cents according to the consumption, extent of installation and number of daily hours of service. These contracts, of which there are a great many varieties, are intended to cover almost every condition of service.

Mr. Freeman declared, that personally, he believed a differential rate, one involving a reduced average unit charge in proportion to the hours of burning of the installation would better serve the interests of both the company and the public. He believes that such a system of gradual reduction would be better than sudden drops that were governed by contracts embracing guarantees for specific amounts of service within specific periods. Although, according to Mr. Freeman, most of the wholesale contracts at present in force are based upon the size of the installation as well as the amount of current used, his company had no regular system of inspection. It was admitted that it was possible for a customer to increase the size of his installation secretly and thereby get a lower rate than was warranted, but this was a hardship which the company could not avoid entirely.

Mr. Freeman stated that in certain portions of Brooklyn, and in Coney Island, his company insisted on collecting weekly for service, but that this was merely a business protection for the company, and in no wise affected the rate or discriminated against similar customers to whom monthly bills were rendered. Mr. Freeman said that copies of the company's contracts and all of the riders had been sent to all the customers of the company, and that it was the intention to send notice of every modification of existing contracts. Mr. Freeman submitted a new power contract which his company intended to make effective Oct. 1. It was a three-year contract subject to a monthly minimum of $50, and a guaranteed consumption of 30 kw-hours per month per hp of motors connected. The charge for current was 10 cents per kw-hour for the first 25 hours use per month of the maximum demand, 5 cents for the second 25 hours use and 3 cents for the excess of 50 hours' use per month of the maximum demand, and from the 3-cent rate discounts are allowed for quantities from $25 to $1,000 per month, ranging from 5 to 50 per cent, such discount being allowed only from the portion of the bill figured at 3 cents.

Mr. Carleton Moey, of the Queens Borough Gas & Electric Company, testified that his company was using two forms of contract for light and power contracts. The base rate for lighting is 15 cents per kw-hour, but there is a rate of 10 cents for sign lighting and a rate of 6 cents for heating, cooking and automobile charging. The number of these cheaper contracts, Mr. Moey said, was limited. The company also allowed discounts which in certain cases, it was brought out, might reduce the rate to 3½ or 4 cents. Mr. Moey said that all the company's rates were published, so that any customer could take advantage of them.

Contracts for Energy from the Connecticut River.

The Marlboro Electric Light Company of Massachusetts has contracted with the Connecticut River Power Company for a portion of the service to be supplied by the station at Vernon, Vt. The Marlboro company recently entered into a contract with the town of Berlin to light its streets, fixing a relatively low rate for the service. It is now stated that one purpose the company had in fixing these rates was to secure franchise rights in Berlin which would permit of the extension of the company's lines from Northboro to the boundary of Clinton, where it would be easy to reach the lines of the Connecticut River company which are to supply power to the Lancaster Mills. The Marlboro company is also negotiating with the town of West Boylston to supply it with street lights.

Boston Edison Company's Illuminating Engineering Department.

The Edison Electric Illuminating Company of Boston opened a Department of Illuminating Engineering on Sept. 1 on the fourth floor of its general offices at 39 Boylston Street, Boston. The inauguration of this work is probably the first instance in which a central station organization has formally undertaken to help its customers save money on their lighting bills or get more useful light for the same money. In the past most companies have rested content with the conditions on their customers' premises, regardless of whether the illumination represented the highest or the lowest standards of efficiency. While the Boston company, in common with other progressive managements, has always been glad to advise its customers regarding the efficient use of electricity for light and power, there had not been a definite organization whose object was to handle such questions in a broad way on an engineering basis. The purpose of the new division is well expressed in the designation adopted on the door of the department:

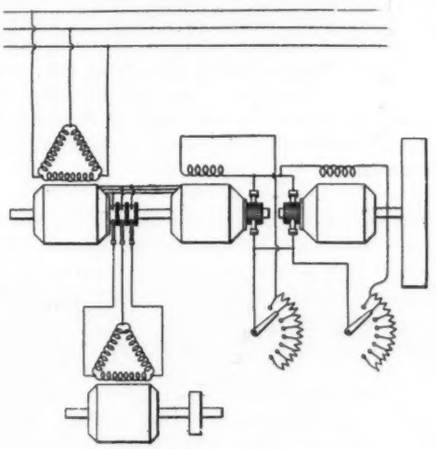
"Commercial Illuminating Engineering.—Louis Bell, Ph.D., H. W. Moses.—For Advising and Assisting Customers How to Use Electricity Most Efficiently."

Previous to the opening of the division of illuminating

engineering the plans of the company were extensively advertised in the Boston daily and suburban press. In addition, 25,000 letters to customers were sent out by Mr. Wm. H. Atkins, general superintendent of the company, explaining the purpose of the new division. Ten telephone replies to this letter were received almost immediately, and the return mail brought 45 other inquiries. A consultation room has been fitted up for the use of the division.

A Motor-Converter for Load Equalization.

A patent issued on Aug. 4 to Mr. J. S. Peck relates to the use of a motor-converter in connection with a flexibly-connected fly-wheel as a combined frequency changer and instantaneous load equalizer on the polyphase supply circuit. The motor-converter was described in our issue for Feb. 16, 1907. It consists of an induction motor mounted on the same shaft with, and directly-connected electrically to, a rotary converter. The current supplied by the secondary of the motor to the alternating end is at a frequency much below that of the supply system. The inventor proposes to apply current obtained at the lower frequency directly to low-speed induction motors



PECK LOAD EQUALIZER.

for driving rolling mills, etc. In order to equalize the instantaneous loads on the supply system, a motor having a heavy fly-wheel for storing energy rotatively is driven from the commutator of the motor-converter. When a rolling mill demands an abnormal amount of power the lowering of the voltage at the commutator of the motor-converter allows energy to be returned from the fly-wheel into the converter and thence to the rolling-mill motor. The advantages claimed for the systerm are a low frequency for the rolling-mill motor and an equalization of the instantaneous loads on the supply circuits.

Electric Driving for Rolling Mills, Mine Hoists, Etc.

A patent recently granted to Mr. H. Ward Leonard, based on an application filed February 6, 1897, covers quite broadly in its claims the principle of automatically regulating the energy supplied to a motor whereby while the voltage is varied inversely as the current, the power is maintained constant within certain limits. Some years ago Mr. Leonard referred in these columns to this invention, then in the Patent Office, in connection with what was at that time described as the Ilgner system of electric drive for rolling mills. The invention is particularly applicable to rolling mills, mine hoists, locomotives and wherever large motors of variable torques and speeds are used. One of the features of the invention is an automatic slip regulator whereby a fly-wheel is caused to give up its energy and thus equalize the demand for current. The specification states that in carrying the invention into effect a rheostat is connected in the field circuit in a dynamo which supplies part of all the energy for the working motor to be controlled; that is to say, instead of regulating the working motor directly, the source of energy is regulated. The rheostat is operated automatically, preferably by a small dynamo whose armature is connected in series with the driving motor for the dynamo which supplies the energy to the working motor, so that as the load on this motor varies and hence the amount of energy taken from the main source is varied, the armature of the small dynamo is caused to rotate an adjustable load or other device; and by means of a suitable driving connection the rotation of this armature adjusts the position of the rheostat lever to control the strength of the dynamo which supplies the energy to the working motor.

CURRENT NEWS AND NOTES.

MEXICAN TROLLEYS.—U. S. Consul W. W. Canada reports from Vera Cruz, Mexico, as follows: It is stated that an American company has a project on foot to purchase the mule tramway lines and other properties at Orizaba in the sum of $625,000 gold, with the intention to change them to electric traction. Water power is abundant in that vicinity.

EMPIRE STATE CONVENTION.—Mr. C. H. B. Chapin, secretary of the Empire State Gas & Electric Association, announces that the annual meeting of this association will be held in the United Engineering Societies Building, 29 West Thirty-ninth Street, on Oct. 7, 1908. Among the subjects to be discussed are: Public policy work of the association; standards for gas service and standards for electric service, taking as a basis the recent rules of the Railroad Commission of Wisconsin; taxation of gas and electric companies in New York State with a report from the taxation committee; insurance of gas and electric stations; review of the decisions of the public service commissions; electric meter testing with report of the meter committee; accounting with report of the accounting committee; amendments to the constitution and by-laws with a new schedule of annual dues; affiliation with the American Gas Institute and the National Electric Light Association. All of the details of the program have not been completed, but it is expected that the meeting will be exceptionally interesting. The members will visit the electrical show, by invitation, which then will be in full swing at Madison Square Garden.

THREE-CENT FARES.—At Cleveland, Ohio, on Sept. 5. suit was filed in the Common Pleas Court, by James K. Farasey, a taxpayer, asking that the security grant of the Cleveland Railway Company be declared null and void and the lease of the property to the Municipal Traction Company, organized by Mayor Tom Johnson, be set aside. Frauds in the financial interests by city officials are named as a basis for the suit. The petition declares that the Municipal Traction Company is a fraud upon the city and its taxpayers, is without legal or financial responsibility, and is wholly and solely controlled and dominated by Johnson. It is further declared that the franchise grant is a fraud because it provides a higher rate of fare than was offered by the Cleveland Electric Railway Company of seven tickets for 25 cents, with universal transfers. It is charged that the public funds of the city were used to promote the interests of the 3-cent-fare lines. Five hundred thousand dollars is named as the sum so used. After asking that the ordinance be declared null and voil and the lease be set aside the petition prays that the company be enjoined from operating under the franchise. The petition further asks that a receiver be appointed to take charge of the property of the Municipal Traction Company, which, it declares, is utterly insolvent, having liabilities vastly in excess of its assets, and that the same be administered in the interests of the city of Cleveland.

TIMING TELEGRAMS.—The Georgia Legislature has passed an act requiring telegraph companies to endorse on telegrams delivered the date and time when received at the sending office, and prescribing a penalty of $25 for failure to deliver within a reasonable time after filing.

CONCRETE TELEGRAPH POLES.—The Pennsylvania Railroad Company is to experiment with concrete telegraph poles along its right of way, and will try them first between Chicago and Pittsburg on an exposed stretch. If satisfactory, it is said, the entire system will have such poles.

BAR HARBOR TRANSMISSION LINE.—The Bar Harbor & Union River Power Company has completed its transmission line from the Ellsworth power plant to Bar Harbor, a distance of about 23 miles. Service is now being supplied regularly, and a line is being built to connect the system with Bangor.

STUDYING AMERICAN TELEPHONY.—Advices from Rome state that the Italian Minister of Posts, Telegraphs and Telephones, in view of the immediate increase in the telephone service, has decided to study the best American systems on the spot with the object of introducing them. To this effect he has just sent Cavaliere Alberto Faranda, Director of Telephones in Rome, to the United States with the mission of studying telephonic development, especially the automatic system.

VERMONT ELECTRICAL ASSOCIATION.—The Vermont Electrical Association will hold its annual meeting at Bennington, on Sept. 16 and 17. Mr. C. C. Wells, of Middletown, is secretary of the body. As the Edison Association will be in session at the same time at Lenox, it is expected that some of the members of the latter body will be able to visit Bennington; and it is hoped that President Eglin, of the National Electric Light Association, will be present to make an address.

HYDRO-ELECTRIC POSSIBILITIES.—In discussion of his paper, presented before the Western Society of Engineers, at Chicago, Sept. 2, on "The Analysis of a Hydro-electric Project," Mr. H. von Schon made some statements as to hydro-electric possibilities in the United States which set those in attendance to thinking. He showed that there are water powers of considerable size within transmission distance of most of the large cities of the United States, and that the available water power of the country, if proper water storage provisions are made, would suffice for all present power requirements.

LONDON ELECTRICAL CONGRESS.—It is stated that in connection with the International Congress on Electrical Units and Standards which, on the invitation of the government, is to assemble on Oct. 12 next at Burlington House, London, the Lord Mayor will give a banquet to the delegates at the Mansion House. One of the objects of the conference is to arrive at conclusions that may bring about agreement in the definition of electrical units, which form the basis of legislation in different countries. The president of the Board of Trade has appointed Lord Rayleigh, Prof. J. J. Thomson, Dr. R. T. Glazebrook, Sir John Gavey and Mr. F. P. Trotter to be the British delegates to the conference.

100-WATT TUNGSTEN LAMP IN BOSTON.—In referring to the introduction of the tungsten lamp in Boston, in the issue of Sept. 5, it should have been stated that the Boston Edison Company advises always to use the present 100-watt tungsten lamp in a pendant position, and preferably the 40-watt and 60-watt lamps in an upright or pendant position in order to prolong their life. The excess charge on tungsten lamps is $1 for the 40-watt pear-shaped plain or bowl-frosted size, $1.10 for the 60-watt and $1.25 for the 100-watt size. The company's policy is to make an allowance or to supply extra lamps in case the life of the lamps does not average the expected value of about 700 hours.

LIGHTING PAY STATIONS.—The Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., has recently adopted a system of pay stations, it being an arrangement whereby various banking institutions in different parts of the city undertake the receipt of gas and electricity bills for which payment is tendered by customers of the company. Mr. Charles M. Cohn, secretary of the corporation, informs us that it is part of its policy of usefulness to patrons, and is intended to serve as a convenience in saving them the trouble and expense of a monthly trip to the center of the city, where the main offices are located. There are now 14 such pay stations situated in various sections of Baltimore and its suburbs; and already about 20 per cent of the bills paid is received at these points each month.

CAR LIGHTING ENGINEERS.—At a preliminary meeting held in Chicago, Aug. 24 and 25, the Association of Car Lighting Engineers was formed and the date of the first annual meeting was fixed for Nov. 18, in Chicago. The president is Mr. A. J. Farrelly, of the Chicago & Northwestern Railway; first vice-president, Mr. E. M. Cutting, of the Southern Pacific; second vice-president, Mr. A. J. Collett, of the Union Pacific; secretary, Mr. G. B. Colegrove, of the Illinois Central. Committees have been appointed to report on illumination, wiring connectors, lamps, organization, history of electric lighting on steam railroads, axle lighting, straight electric lighting, storage batteries, straight storage lighted cars, head end systems, entertainment. These committees and the executive committee include a number of the leading railroad electrical engineers and electricians, and some very useful work is expected of the new organization.

EDISON CONVENTION.—According to the plans and announcements made, the Association of Edison Illuminating Companies will hold a very successful convention at the Hotel Aspinwall, Lenox, Mass., Sept. 15 to 17. An excellent program has been prepared by President Alex. Dow. Papers will be presented for discussion on the following subjects: Methods of handling accidents to employees; the status of the special customer; a study of residence lighting; methods for preventing the destruction of generators in case of short circuit; measurements with portable testing instruments; modern substation for Edison illuminating companies; some advertising notes with particular reference to the advertising value of the display room; recent automatic stoker practice; contracts for sale or purchase of large blocks of power; present European lighting methods; the question of a standard policy as to metallic filament lamps. Dr. C. P. Steinmetz will deliver a lecture on "Electrical Engineering Problems of the Future." A number of entertainments have been planned suitable to this beautiful season in the Berkshire Hills.

OVERHEAD WIRES IN LONDON.—There are still some overhead wires in London. Since 1899, when the Corporation took in hand the work of supervision, about 24¾ miles of derelict wires in the city have been removed. All owners of overhead wires are now required to identify them by having a perforated zinc label attached, and these identification marks are registered. The authorities consider that it should be made obligatory upon persons who desire to erect wires to give notice of their intention and to submit plans. At present anyone may fix overhead wires, so long as they inform the Corporation within a month. As a result, hundreds of wires have been put up without notice. Last year 27 derelict and unidentified wires, 546 yards long, were removed. A large number of disused wires and attachments were also taken down. There are now 155 owners of lines in the city. A total of 733,200 spans of wire cross the public thoroughfares. There has been a net increase of 1211 miles of National Telephone Company's wires. The tendency of that company is to take down its open wires and small cables and to substitute heavy cables, the larger of which contain as many as 368 wires, the number of wires thus increasing in a greater ratio than the spans.

Redondo Generating Station of the Pacific Light & Power Co.

ONE of the most striking examples of recent steam power-plant design is the plant of the Pacific Light & Power Company, operating at Redondo, Cal. The most radical departure from recent Eastern central station practice lies in the adoption, as prime movers, of reciprocating engines of one of the most modern types in lieu of steam turbines.

Considerably at variance with the customary method of procedure with large plants, the purchasers, desiring to secure the most modern and economical steam power plant possible, entrusted the design of this station to a firm of contracting engineers, with whom was placed a fixed sum contract for the entire installation.

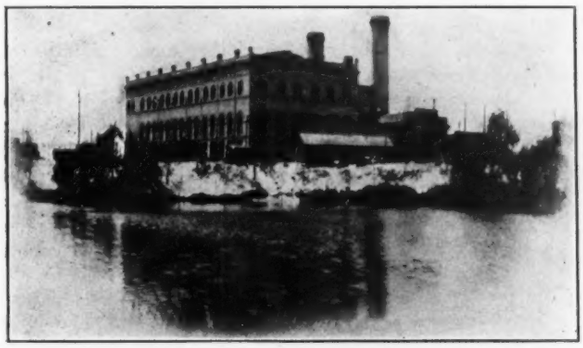


FIG. 1.—EXTERIOR OF POWER HOUSE.

As the customary guarantees for steam consumption of prime movers, efficiencies of boilers and various auxiliaries, under ideal conditions, were considered of no protection under commercial conditions of variable load, a definite complete plant fuel consumption was guaranteed based on commercial railway load, subject to penalty and bonus stipulations.

A further feature of interest was the provision of the contract that the plant be started and operated by the contractor for a period of at least three months previous to the fuel consumption test, also during test, thus thoroughly organizing the operating crew and perfecting the adjustment of the apparatus.

As a result of undoubtedly the most elaborate power-plant test ever undertaken, the committee in charge reported an actual fuel consumption under commercial load, which has not only earned for the contractors the largest amount of money ever paid as a bonus on a steam power-plant guarantee, but has also been less than the fuel consumption of any central station of published record.

The plant has a nominal rating of 15,000 kw, there being three 5000-kw units. The contract covered the entire plant installation, including machinery foundations excepting the switchboard, building, circulating water-pipe line, wharf and any other work outside of building.

In order to obtain an ample supply of water for condensing purposes, the plant was located at Redondo, a beach town 18 miles southwest of Los Angeles. Eighteen thousand volts were determined as ample for this distance of transmission, the alternators being wound for this potential without the use of step-up transformers.

The Pacific Light & Power Company is engaged in supplying energy to both lamps and motors, although the greater part of the energy from this station is used for operating the railways of Los Angeles and suburban towns, including all of the well-known Huntington systems of interurban railroads.

The fuel situation is ideal. Crude oil is obtained from wells near the plant. Owing to the system of oil firing in use, the boiler room labor cost is at a minimum. Consideration of these facts in connection with the remarkably low fuel consumption attained, warrants the statement that this plant is developing energy at a cost probably lower than that of any other large American central station.

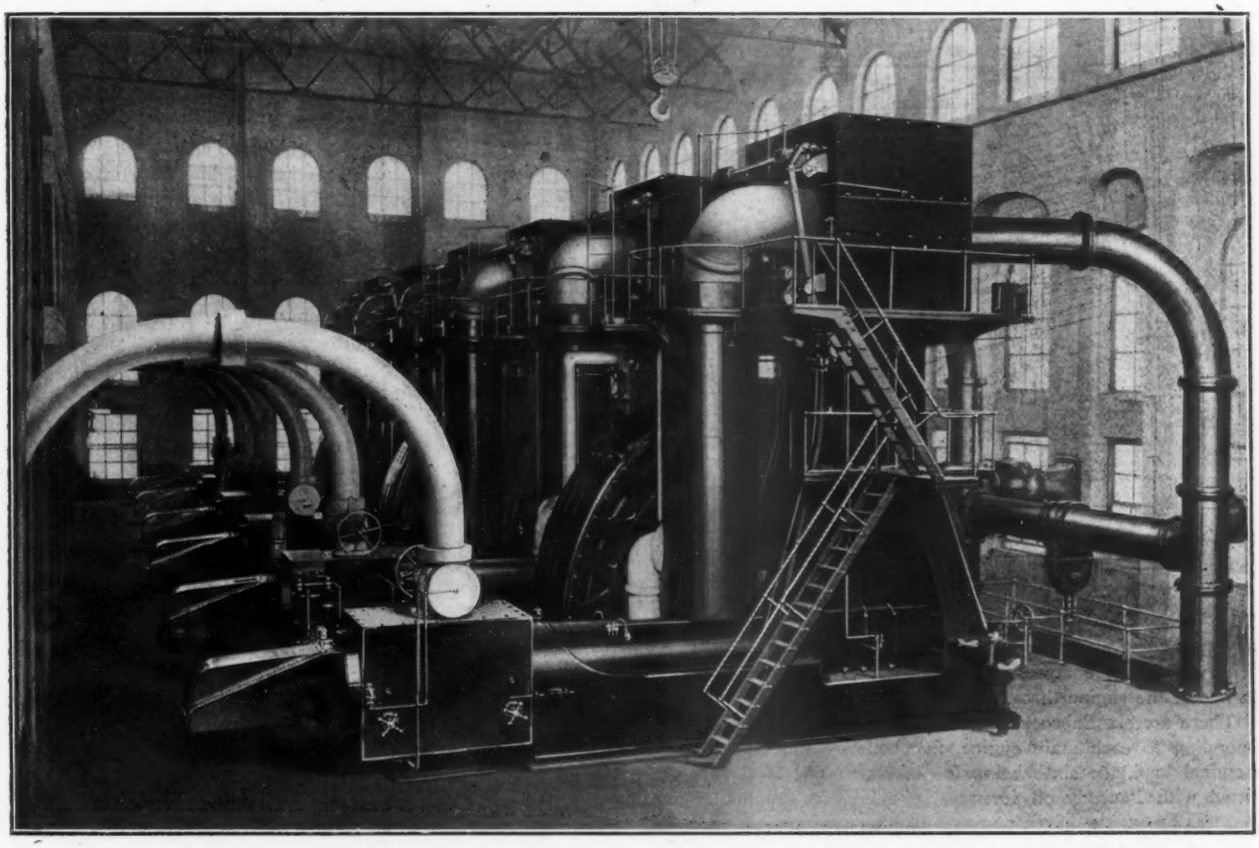


FIG. 2.—INTERIOR OF GENERATING STATION.

GENERAL ARRANGEMENT OF PLANT.

The panel system of plant design was followed, as will be noted from the accompanying drawings. Owing to the fact that each main engine consists in reality of two compound engines connected to a common shaft, each having an independent steam and exhaust connection, a further subdivision has been possible with each unit in the connection of one-half of the panel of boilers to each high-pressure cylinder, and the provision of a separate condenser and air pump for each low-pressure cylinder, giving in effect the freedom from break-down corresponding to six instead of three plant units.

All auxiliaries, excepting the air pumps, are engine driven, operating non-condensing, the steam exhaust being utilized in feed water heaters. The air pumps for each unit are motor driven, energy being furnished from the main generator, thereby insuring the gradual starting of the two air pumps in synchronism with the main engine.

All boilers are fitted with superheaters, designed for approximately 100 deg. Fahr. supertemperature at the boiler nozzles, giving from 80 deg. to 90 deg. at the main engine throttles. The working steam pressure is 175 lb. per square inch, maintained at the engine throttle.

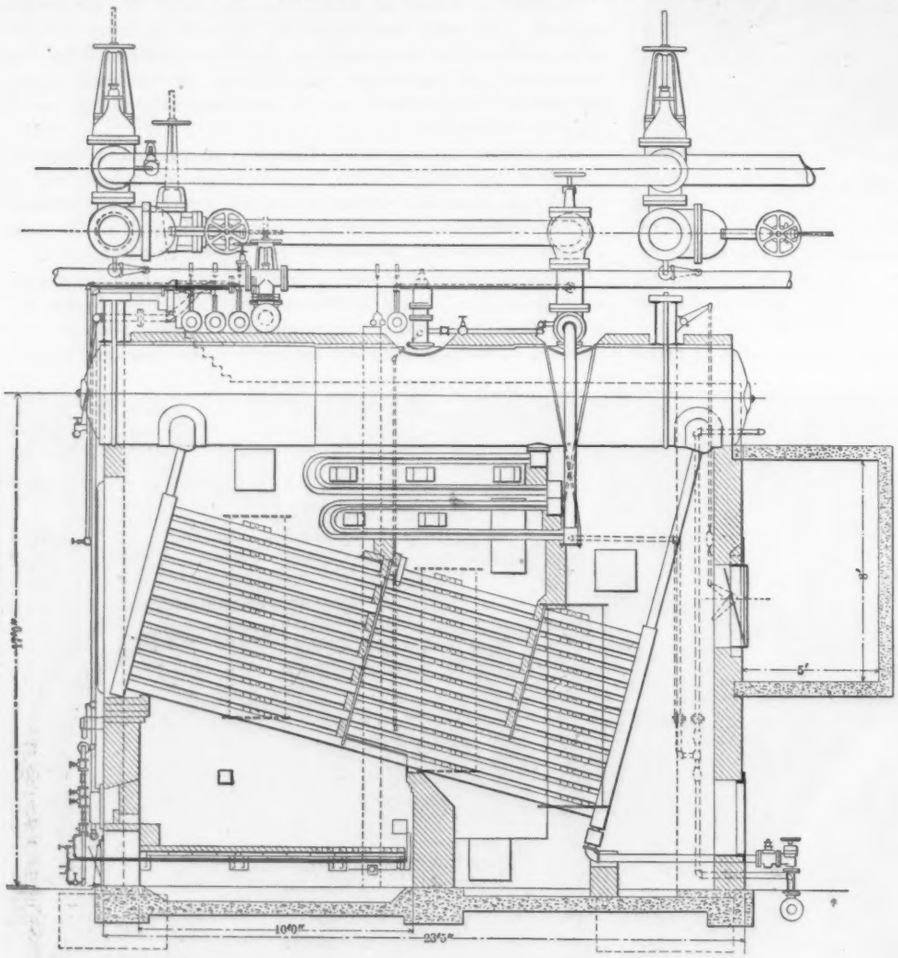


FIG. 3.—SECTIONAL ELEVATION OF FURNACE USING OIL FUEL.

There are six Babcock & Wilcox boilers in each panel corresponding to each main engine, five boilers being operated on nominal load, the sixth being for reserve. The 18 boilers are fitted with Peabody oil furnaces. Fuel oil is supplied to the burners by engine-driven pumps. The furnace affords the most efficient boiler performance obtainable with crude oil. The furnace is fired from the bridge wall forward, but is controlled at the boiler front. It offers a large volume diverging in the direction of the flame. A large surface of brick work is exposed, insuring a complete combustion. The distribution of flame is over a large area of boiler heating surface, preventing localization of heat and blow-pipe action and minimizing the possibility of burning out tubes. The furnaces are arranged for the use of three burners per boiler.

ENGINES.

The plant includes three 34 and 70 in. x 56 in. combined double horizontal and vertical, compound, side-crank, McIntosh & Seymour automatic grid-iron valve engines, each directly connected to an alternator. Each engine has two horizontal high-pressure cylinders and two vertical low-pressure cylinders.

Each engine is fitted with a McIntosh & Seymour compound delaying dash-pot for parallel operation. They control the governor weights for a small fraction of a second, preventing the oscillation of two or more units becoming amplified and from destroying parallel operation of alternators. Each engine is also fitted with an electrically operated speed changing mechanism which is situated in the governor, and is driven by a small induction motor, and is controlled from the switchboard gallery. This arrangement not only allows the engine speed to be increased or decreased by four or five r.p.m. to bring two or more engines into synchronism, but is also used to divide the load between engines.

EXCITERS.

Situated beside each main engine is a 75-kw General Electric exciter generator direct-connected to a Harrisburg tandem-compound, non-condensing, piston-valve, side-crank, automatic enclosed self-oiling horizontal engine.

AUXILIARIES.

The plant contains six Wheeler "Admiralty" surface condensers, one being for direct connection to each low-pressure cylinder of each main engine. There is furnished in connection with each condenser one Edwards vertical triplex air pump, driven by a 25-hp General Electric induction motor mounted on an extended base and connected to the pump by a rawhide pinion; only one-fifth of the rated power of this motor is required during nominal conditions of load. There are provided three centrifugal circulating pumps directly connected to Harrisburg tandem-compound, non-condensing, piston-valve engine. There are four Snow duplex horizontal boiler-feed pumps and three Goubert vertical auxiliary feed water heaters of the multiple flow type.

The air pump is a single-acting machine having three cylinders, each 16 in. in diameter with a 10-in. stroke. It is of the suction-valveless type, all suction valves being dispensed with. The condensed steam and non-condensible vapors flow continuously by gravity from the condenser to the base of the pump and are removed by a conical bucket or piston, which works in a base of similar shape. By the action of the bucket, the water is projected without shock at a high velocity through the ports which are cast in the sides of the working barrel. The rising water is followed by a rising bucket, closing the ports and forcing the air and water through the discharge valves of the pump. The centrifugal pumps are of the double-

suction type specially designed for high efficiency service. Each pump is provided with an outboard bearing of the ring-oiling type, the pump and bearing being mounted on an extension of the engine base. Each of the boiler-feed pumps is of ample size for one unit, so that one may always be held in reserve. These pumps operate non-condensing, the exhaust steam being led to the feed-water heater.

FUEL OIL PLANT.

Fuel oil is stored in large steel tanks having a storage volume

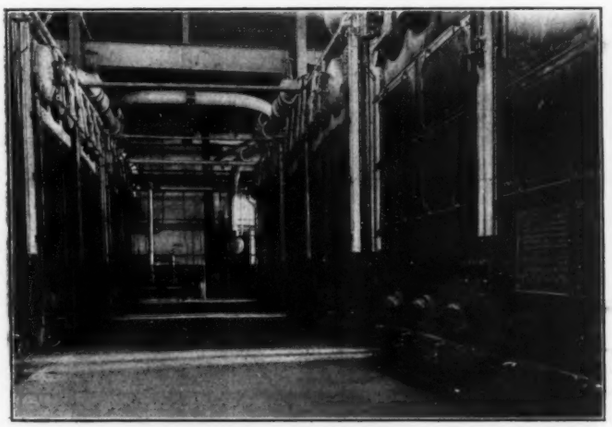


FIG. 4.—FIRING ALLEY BETWEEN OIL-FUEL BOILERS.

for from 30 to 45 days supply. The oil is pumped into auxiliary tanks outside of the building at one end of the boiler room, each tank having the volume of 1000 barrels. The top of the auxiliary tanks is on the same level as the boiler room floor line to conform to the Underwriters' requirements. The grade line is about 14 ft. above the floor of the tanks, and the surrounding earth is withheld by means of circular retaining walls. These tank pits are roofed over and properly ventilated. All pipes connecting to the tanks have valves located on the boiler room side, there being a 3-ft. concrete wall between the tank compartments and the operator. There are fire partitions with fireproof doors between adjacent tanks. The manhole covers in each tank are padlocked, so that it is impossible for an operator to set fire to any of the tanks as finally designed, although a fire did occur before these precautions were finally adopted.

An automatic system of regulation is employed, invented by J. R. Atchison and C. R. Weymouth. The oil is pumped under pressures varying from 10 lb. to 50 lb. per square inch, depending on load conditions; there being a uniform oil pressure throughout all portions of the plant, all burners being wide open or nearly so. The amount of oil burned, with the variations of load, is controlled by the pressure of oil at the oil pumps, the intensity of fire increasing and decreasing in all boilers simultaneously. The oil pressure is automatically controlled by a steam pressure regulator, the variations in oil pressure and intensity of fire being such as to maintain a uniform steam pressure on the plant.

Steam for atomizing purposes is supplied to oil burners by a separate low-pressure main, the pressure in this main being automatically controlled by variations of the oil pressure in the oil main. A ratio regulator is used, automatic in its action, operating to maintain such steam pressure in the low-pressure steam main as is necessary to atomize the particular amount of oil burned, corresponding to any momentary oil pressure. In this particular plant it is found that the proper amount of steam for atomizing purposes is furnished under a steam pressure equal to three times the oil pressure plus 30. This relationship will vary with the type of burner used.

The air supply for combustion is governed by a damper controller, also automatic in its action, which increases the damper opening with an increase in oil pressure and vice versa. The movement of the controlling lever is due to the oil pressure acting on a diaphragm. This movement is opposed by the action of a spring, such that the amount of movement on the main lever is proportional to the oil pressure. This movement is multiplied through a hydraulic cylinder connecting to a rock shaft running over all of the boilers in one panel. Each boiler damper is connected to this rock shaft. The connecting levers are set at such angularity, with respect to the connecting rods operating the dampers, as to give the proper air supply for the various ranges of loads, the final adjustment being from actual trial at the plant.

In actual operation and test, it is found that this automatic system of control is safe, reliable, and meets with the approval and hearty endorsement of the firemen. Owing to the fact that the firemen's work is very much simplified by the use of these regulators, they are as much desired by the firemen of the plant as by the management; were it not for this accord, such automatic contrivance could not be successfully installed and operated by the class of labor met with in the ordinary fire room.

PIPING SYSTEM.

All of the piping for the plant except for some of the minor auxiliaries is arranged on the panel system, dividing the plant into three independent units. In the layout of this station it was desired to minimize the diameter of the steam mains. On each high-pressure cylinder of each engine, the throttle valve is for a 14-in. pipe. Owing to the necessity for long radius bends and the desire for flexibility, it was determined not to employ any steam pipes over 14 in. in diameter. It was finally decided to connect three boilers in each battery to each side of each unit, thus providing a greater flexibility of service without increasing the cost of the piping system; hence, in so far as the main steam piping is concerned, the plant can be considered in effect six independent units. The main steam piping was anchored to the building walls and building columns located with this idea in view. It was found, however, that the columns were not sufficiently rigid for anchorage purposes, and it became necessary to install a cross system of bracing from wall to wall. Drainage is afforded by locating a large receiver drum in each line of piping, as shown in the drawing.

CHIMNEYS.

There are two reinforced concrete chimneys each 13 ft. in

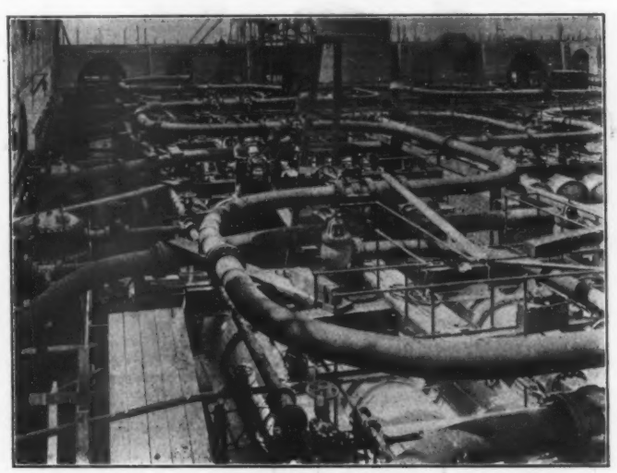


FIG. 5.—VIEW OF BOILER ROOM DURING CONSTRUCTION.

diameter and 125 ft. in height. Each chimney is arranged for two units, the plant being so designed that a fourth unit may be added to the station and connected to the second chimney. The chimney gases pass from the boiler to the chimney through specially designed reinforced concrete flues; these have proved eminently satisfactory for the work, although slight heat cracks in the concrete appear in various places.

GENERATORS.

The three main generators, manufactured by the General Electric Company, are of particular interest on account of the

extremely high e.m.f., 18,000 volts, for which they are wound. These generators are 50-cycle, three-phase machines, rated at 5000 kw, and are of the flywheel type. The following data may be of interest:

Floor space required	31 ft. by 6 ft. 9 in.
Diameter of stator	28 ft. 6 in.
Diameter of rotor	25 ft.
Radius of gyration	8.8 ft.
Weight of stator	186,000 lb.
Weight of rotor	162,000 lb.
Weight of accessories	12,000 lb.
Total weights	360,000 lb.

The commercial efficiencies at unity power factor are as follows:

1.25 load	96.5 per cent
1.00 load	96.2 per cent
0.75 load	95.2 per cent
0.50 load	93.5 per cent
0.25 load	88.0 per cent

The armature coils of these generators have withstood a high potential test of 40,000 volts for one minute.

On account of the severity of the specifications in regard to the operation of these generators in multiple with existing apparatus on the transmission system of the Pacific Light & Power Company, the revolving field cores are provided with a squirrel cage winding to prevent hunting. The generator field rheostats are motor operated, being controlled from the switchboard. The starting, stopping and loading of the various units is controlled entirely from the switchboard gallery, located above the boiler room and alongside the main engine room wall.

SWITCHBOARD EQUIPMENT.

The wiring between the generators and switchboard room consists of three No. 4-0 bare copper wires, each in a separate duct on large porcelain insulators. Moreover, there are installed one spare duct and a spare cable for use in case one of the three main lines becomes defective. Each generator is connected through two-way porcelain-mounted selector switches to either of two sets of high-tension busbars located in two separate concrete galleries. The oil switches are of the single-cell, single-throw, four-break, 400-amp type, mechanically connected together in gangs of three poles. These switches are operated by manual remote control.

The entire switchboard equipment was built in the shops of

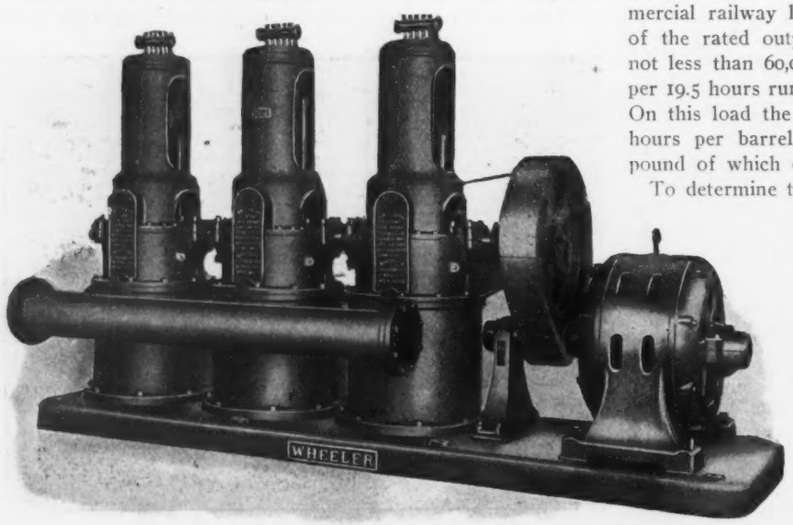


FIG. 6.—MOTOR-DRIVEN AIR PUMPS.

the Pacific Light & Power Company. The operating stand and the instrument boards are made from well-seasoned oak. The use of wooden construction in this particular was attributable partly to the saving in expense in building wooden structure instead of marble, but was due principally to the fact that on account of the rapid progress of electrical science switchboards rapidly become obsolete, and if built of marble they would be extremely expensive and hard to replace. In reference to the danger from fire hazard in connection with wooden structure, it is to be noted that all of the high-tension alternating-current wiring is communicated to the switchboard instruments through the low-tension wiring of series and shunt instrument transformers, the low tension wiring being permanently grounded. The alternating-current instruments used in connection with the feeders and generators on this switchboard are of the curve-tracing Westinghouse recording type.

The four lightning arresters in the station were furnished by the General Electric Company.

The exciter generators, four in number, are connected to a marble switchboard located on the main engine room floor, the

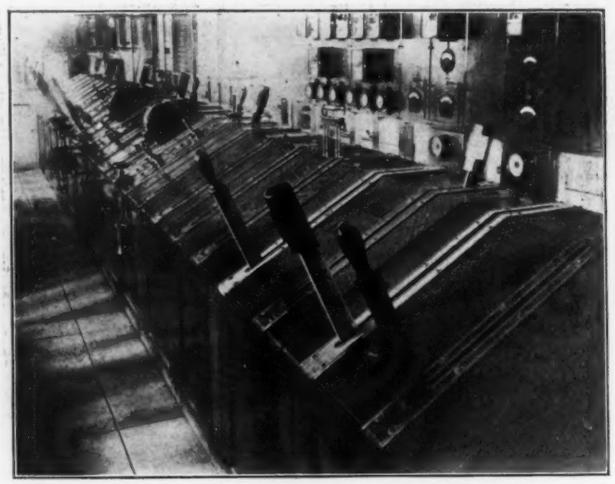


FIG. 7.—OAK SWITCHBOARD OPERATING TABLE.

switches being operated by compressed air and remotely controlled. The field rheostats of the main generators are driven by remote-controlled motors.

The operating room and galleries are built of reinforced concrete and are entirely fireproof in every detail.

PERFORMANCE.

The contract covering this station embodied an economy guarantee providing for a 15-day test on one unit on a commercial railway load, under any load curve within the limits of the rated output of the generator, the total output being not less than 60,000 kw-hours nor more than 78,000 kw-hours per 19.5 hours running, there being 4.5 hours stand-by each day. On this load the contractor guaranteed an output of 170 kw-hours per barrel of oil, each barrel weighing 334 lb., each pound of which contains 18,500 b.t.u.

To determine the performance of the plant each of the contracting parties appointed a representative, the two jointly selecting a neutral party. The representative for the Pacific Light & Power Company was Mr. Edward S. Cobb, chief engineer. The representative of Chas. C. Moore & Company, the contractors, was Mr. C. R. Weymouth. The neutral member of the testing committee was Prof. C. L. Cory, Dean of the College of Electrical Engineering, University of California. Mr. Cobb was assisted by Mr. Edward R. Davis, electrical engineer for the Pacific Light & Power Company, and Mr. Weymouth was assisted by Mr. G. C. Noble, Professor of Electrical Engineering of the University of California; Mr. J. N. LeConte, Professor of Mechanical Engineering University of California, and Mr. H. W. Beecher. Moreover, there were present as contractors' representatives: Dr. D. S. Jacobus, advisory engineer for the Babcock & Wilcox Company; Mr. Harte Cook, testing engineer for McIntosh, Seymour & Company, and Mr. J. H. Lighthipe, engineer for the General Electric Company. The test was one of the most elaborate ever undertaken in connection with a steam power plant. The expense amounted to many thousands of dollars, engaging, including the three shifts for the three parties of interest, about 80 men.

The committee's report gave the result of the 15-days trial as 252.8 kw-hours per barrel of oil. This record is believed to eclipse all published statements of economy of large power plants operating under commercial conditions. For purposes of comparison with other results, the above performance is equivalent to slightly less than 25,000 b.t.u. in the fuel output.

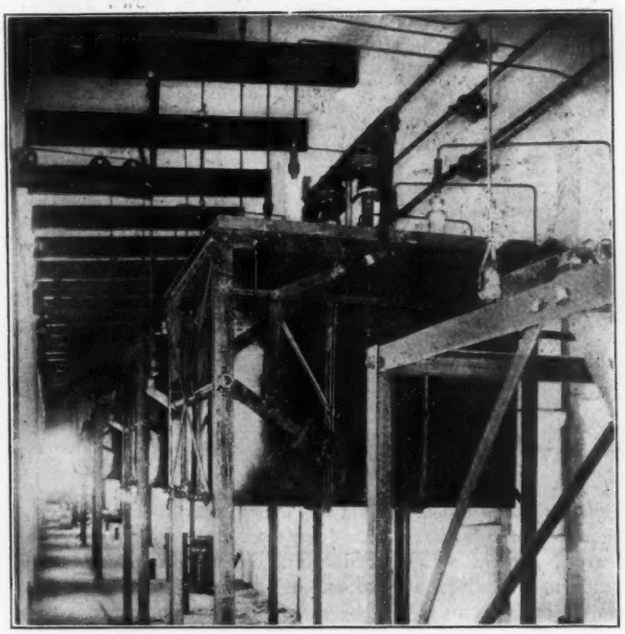


FIG. 8.—HIGH-TENSION SWITCHES.

The bonus earned as a result of the above performance was $363,310, which is undoubtedly the largest bonus ever paid on a steam power plant guarantee. Based on the local market price of crude oil, the fuel saving due to the gain in economy will pay the full amount of bonus in two or three years' time.

COMPARISONS WITH TURBINE STATIONS.

It may be surprising to some engineers to learn that a power plant of this magnitude should be undertaken with the use of reciprocating steam engines in place of steam turbines. The selection, which was made as a result of most extensive inquiries and investigations, Mr. Balch determined in favor of reciprocating engines, from the standpoint of economy at least, has been amply justified. It may be noted that the center distance between the engines is 43 ft. Had the exciters been located elsewhere, it could have been reduced to 35 ft. The first cost has not exceeded by 5 per cent that of a turbine plant.

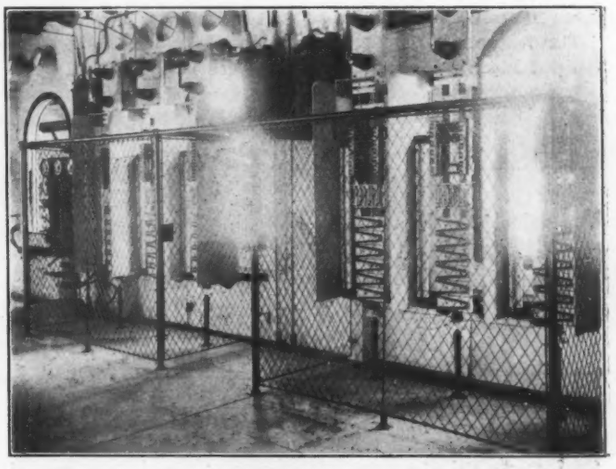


FIG. 10.—LIGHTNING-ARRESTER EQUIPMENT.

The power plant proper was designed by Mr. C. R. Weymouth, in charge of the engineering department of the contractors, Chas. C. Moore & Company, of San Francisco, Cal. The building, which is of reinforced concrete, was designed and erected under the direction of Mr. Edward S. Cobb, chief engineer of the Pacific Light & Power Company.

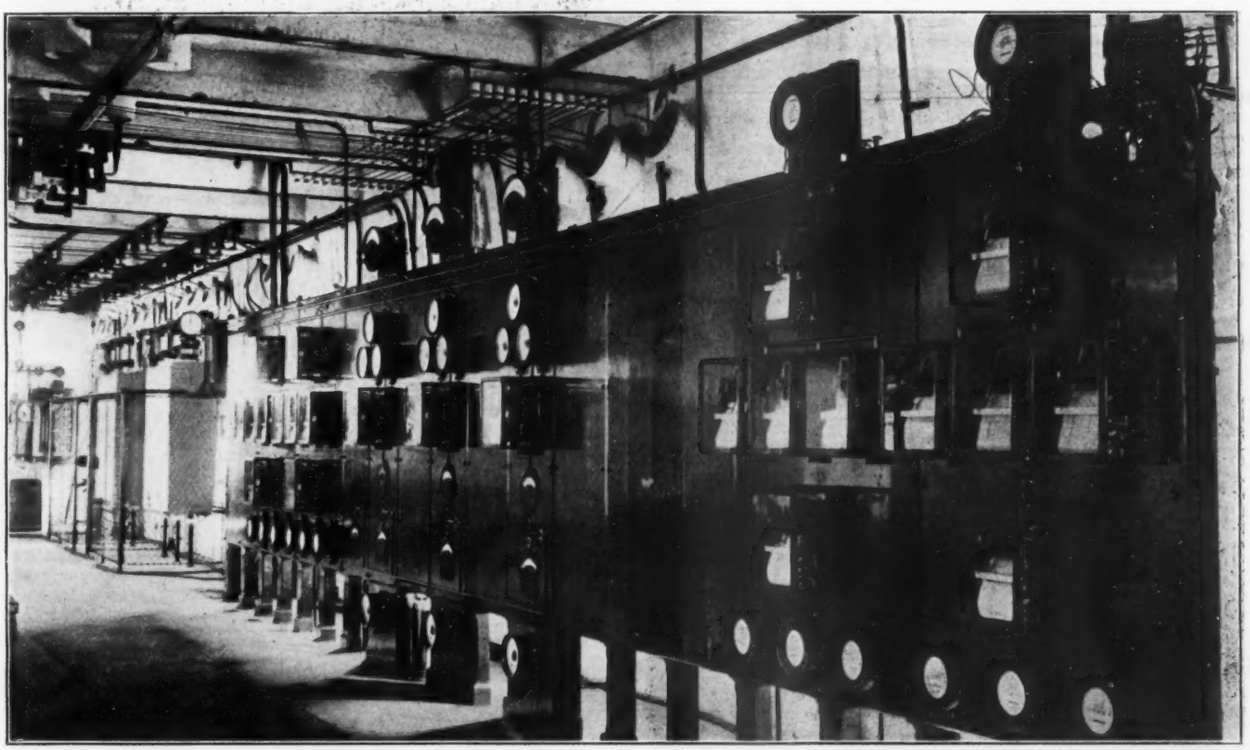


FIG. 9.—GENERAL VIEW OF WOODEN-PANEL SWITCHBOARD CONTAINING LOW-TENSION INSTRUMENTS.

Acyclic Generators.

By J. E. Noeggerath.

As noted in the issue of the Electrical World and Engineer for Feb. 4, 1905, at the January, 1905, meeting of the American Institute of Electrical Engineers, a paper was presented by the present writer dealing mainly with the general theoretical aspects of acyclic generators. In the article below it is the intention to treat the same subject from a thoroughly practical point of view, giving the general aspects of the mechanical design and a few notes on operation.

The features discussed below refer to machines built by the General Electric Company that have been in commercial operation for several months, the shortest time being eight months. Fig. 1 shows a 6-volt, 8000-amp acyclic generator, part of a

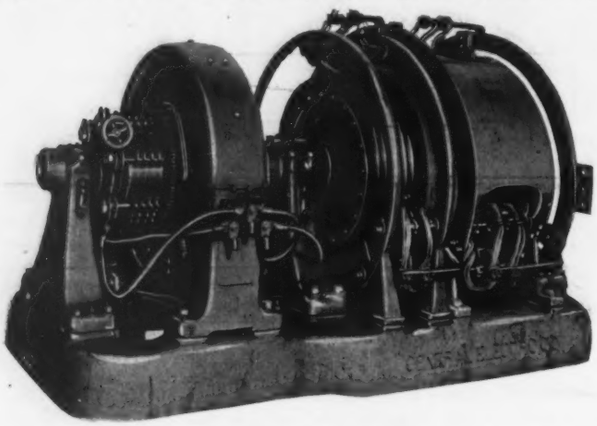


FIG. 1.—SIX-VOLT, 8000-AMP ACYCLIC GENERATOR, 1200 R.P.M.

motor-generator set, and Fig. 2 represents a 2000-kw generator operating simultaneously at 200, 250, 300 and 600 volts for electrolytic processes. An experimental acyclic direct-current auto-transformer capable of transforming 125 volts into 6.25 volts

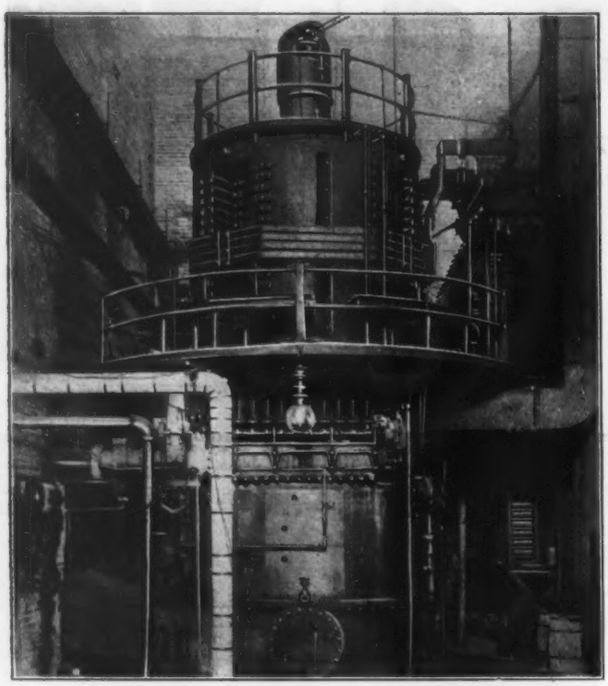


FIG. 2.—2000-KW, 200-250-300-600-VOLT ACYCLIC GENERATOR.

and multiples thereof, and vice versa, is illustrated in Figs. 3 and 4. The latter machine is probably the first acyclic machine that ran as a motor, and the first direct-current rotary auto-transformer. An illustration of two 500-kw turbine-driven acyclic generators supplying energy to a three-wire, 600-volt system having a combined lamp and motor load is shown in Fig. 13.

The principle underlying these machines is shown diagrammatically in Fig. 5. The main factor influence of the design is

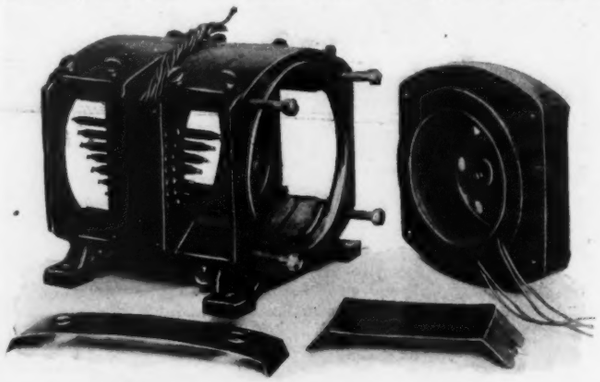


FIG. 3.—STATIONARY PARTS, ACYCLIC DIRECT-CURRENT AUTO-TRANSFORMER.

high peripheral speed. While this may appear at first glance to be a great disadvantage, embodying such problems as the collection of current at speeds up to 25,000 ft. per minute, high centrifugal stresses and so on, it has been the endeavor to benefit rather than to lose by these extreme conditions.

Investigation covering a wide range of conditions have

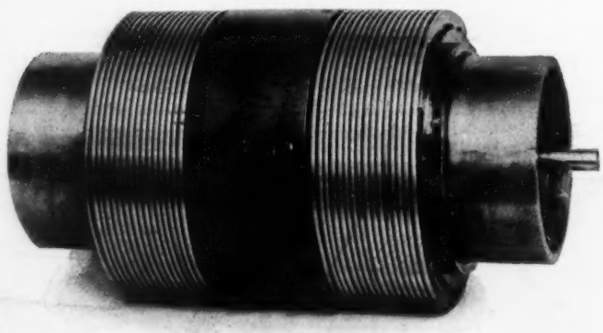


FIG. 4.—ROTOR OF ACYCLIC DIRECT-CURRENT AUTO-TRANSFORMER.

served to show that at high speeds the losses due to the collection of current do not increase appreciably with increasing speed, provided the windage is kept within limits, while,

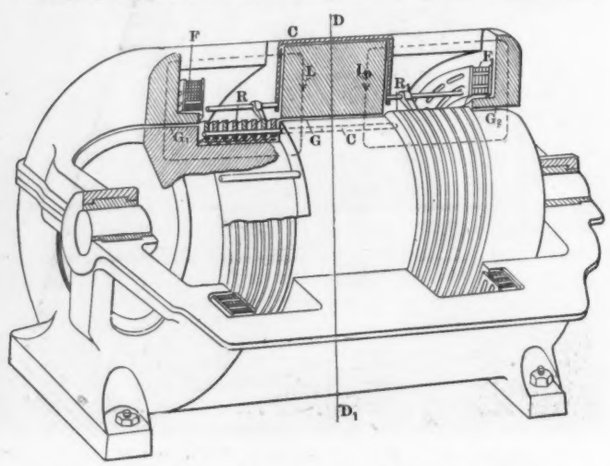


FIG. 5.—PART SECTIONAL ELEVATION OF ACYCLIC GENERATOR.

on the other hand, the excellent ventilating facilities reduce the required cooling surfaces, thereby decreasing weights. Moreover, the high speeds permit of very simple connections on the revolving conductors, where excellent contacts are guaranteed

by the centrifugal strains, making it possible to do away entirely with soldered contacts on the revolving parts.

Considering first the stationary parts, the frame consists of solid steel castings of a cylindrical shape, as shown in Fig. 6, having two rows of large openings and two rows of small openings; the large openings are used for the inspection of the collecting system and the small ones carry off the hot air which

FIG. 6.—FRAME OF 500-KW ACYCLIC GENERATOR.

is thrown out between the collector rings. The air is guided from the collector rings to these small openings by means of deflectors.

The size of the large openings is determined on the one hand by the current output of the unit (size of the brushes) and on the other hand by the core losses. The stationary conductors (Figs. 2 and 3) are fastened on the outside of the frame, and the whole winding is so arranged that by changing these few frame conductors the voltage rating of the generator can be changed without affecting the kilowatt output Of course, the generators can be operated at any e.m.f. from zero to full voltage without change in connections, but the advantage of having the winding arranged in a flexible manner lies in the fact that a generator rated at, say, 500 kw and 600 volts, can be changed to a generator of 500 kw and 300 or 150 volts, etc., by simply reconnecting the frame conductors.

The efficiency of the material of the field coils is high because of the excellent ventilating facilities at hand. Fig. 7 shows that the copper of the main coils is cooled by receiving fresh air directly from the armature. The field-winding spools on the vertical machines are suspended from keys inserted in the frame. Special coils are used at the bearing for the purpose of counteracting the stray fields which tend to convert the shafts into small acyclic generator armatures. The heavy currents which otherwise would be produced therein would be short-circuited through the bearings and tend to destroy them. However, this action is effectively neutralized by the auxiliary coils.

The main features of the armature spider are that all of its material carries flux. It is a solid casting, well ventilated and simple. It carries no binding wires or bands of any kind.

Fig. 8 shows the ducts for the air for which the collector rings and slots in the armature furnish the propelling power. The air enters through openings at the ends (*a*) and is led into a cylindrical chamber (*c*) from which slots (*b*) or openings propel it outward. The cylindrical reservoir is formed by a division of the armature spider into two castings which are separated for a distance under the collector rings.

On horizontal machines there is provided an adjustable ring assembled on the outside of the armature spider and arranged so that the gap between this ring and the stationary part can be adjusted, thereby obtaining a perfect balance of the magnetic side pull. Instead of this arrangement a stationary ring can be used.

From the point of view of an armature-winding department no winding is used on the armature. If the importance of electrical design with regard to core losses and armature reaction are properly taken into account, and the distances between the adjacent conductors and between the conductors and the air-gap are properly selected, there can be used as armature conductors studs insulated by tubes of suitable material. In some instances the armature conductors form part of the collector studs, while in others they are separate.

COLLECTOR RINGS.

As mentioned above, the centrifugal stresses permit a very simple connection to be used between the armature conductors. The studs extending from the end of one collector through the armature to the end of the other collector are very long, and the problem of the change in length by reason of temperature changes is prominently present. It may at first glance appear hazardous to employ a loose connection in a generator, but the high centrifugal strains are able to maintain a good contact. Fig. 8 indicates a movable contact of utmost simplicity, the reliability of which has been proved through a year of operation. The collector ring consists usually of a continuous piece of metal. Two of the more important ways of supporting them are indicated in Figs. 7, 9, 10 and 11. Figs. 9, 10 and 11 show the use of taper-design spacing rings between the collector rings. The end rings of the collectors are forced together under a pressure and a temperature higher than occurring under operating conditions, the taper rings forcing the collector rings outward into a concentric position.

In larger machines, where the axial expansion of the collector rings comes more prominently into action, the design shown in Fig. 7 is used. The supports *A* have flanges, *B*, which are elastic and of such proportions that they give rigid support to the weight of the collector rings, but are sufficiently flexible to allow of bending when put under the strain which occurs, because, when operating, the axial expansion of the collector rings is

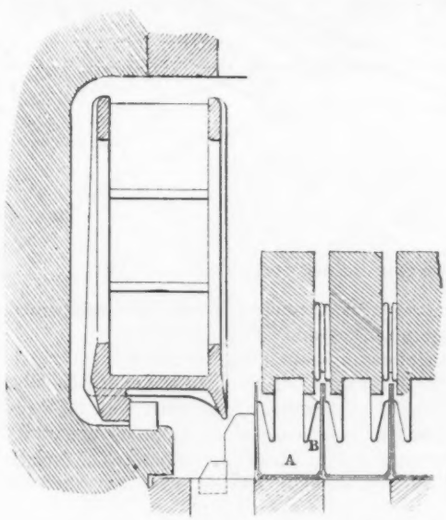


FIG. 7.—COLLECTOR RINGS AND VENTILATOR DUCTS OF FIELD COILS.

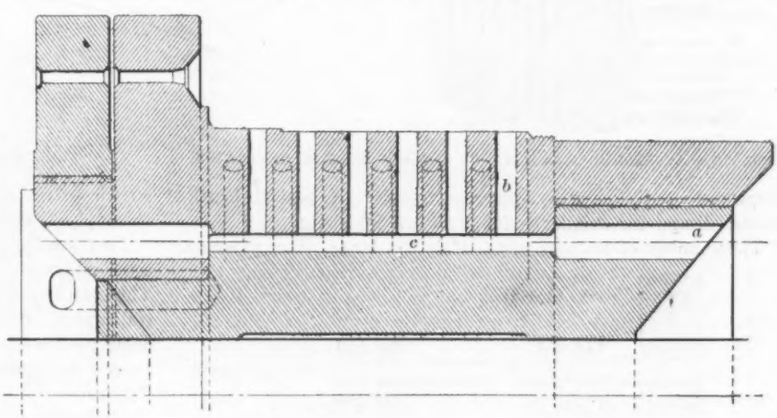


FIG. 8.—VENTILATING DUCTS ON ARMATURE.

greater than that of the shell on which the collectors are mounted. The collector rings form a unit with the collector shell and the collector studs, which, as mentioned above, sometimes include the armature conductors.

BRUSHES.

If a copper brush is used with a rotor revolving at a peripheral speed of 25,000 ft. per minute, under the high-current

FIG. 9.—PARTS OF COLLECTOR.

density and high temperatures usually prevailing it will wear at the rate of from ½ in. to 3 in. in 24 hours. However, it is to be noted that the brush-life has been multiplied many times and put on a commercial basis, due to the fact that the brushes

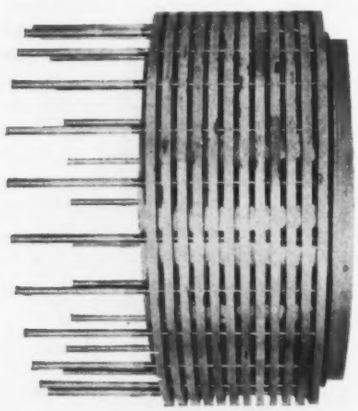


FIG. 10.—ASSEMBLED COLLECTOR OF 500-KW ACYCLIC GENERATOR.

employed consist of two different metals. A typical brush-holder design for smaller units is shown in Fig. 13.

The number of brushes required is not large. For example,

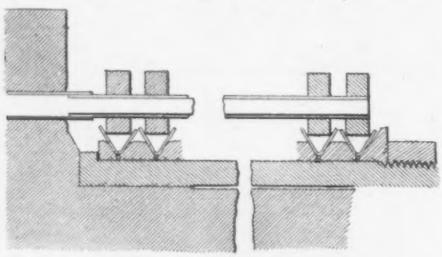


FIG. 11.—DETAILS OF COLLECTOR.

there is now in use a 2000-kw generator operating at 300 volts and 6670 amp which carries only 96 brushes.

OPERATION.

As to operating features, the following facts have been established. Heavy short-circuits in the load circuits of the generators that were in commercial operation were experienced, yet in no case did the generator suffer in any way. The danger limit under short-circuits and overloads consists in the heating alone (not in flash-overs, distortion of the winding, etc.), and the duration of short-circuit is generally so small that no part

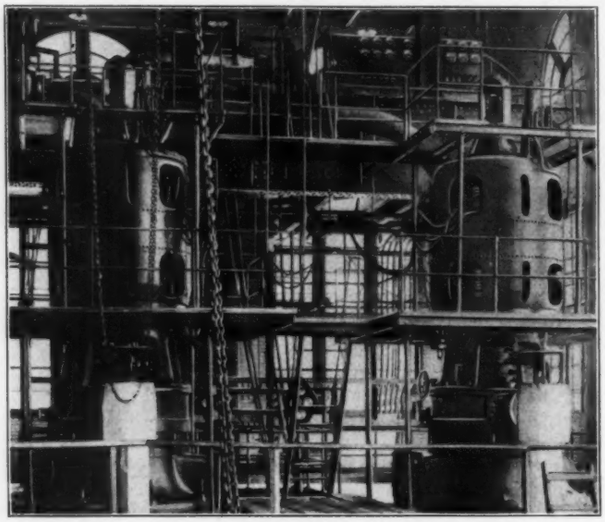


FIG. 12.—500-KW ACYCLIC UNITS.

of the generator becomes dangerously overheated. For the same reason instantaneous loads 200 per cent above normal and more were without influence on the operation. This result does not show that the machines were underrated, but that when running at normal or even at high temperatures the generators withstood and carried sudden overloads readily. This charac-

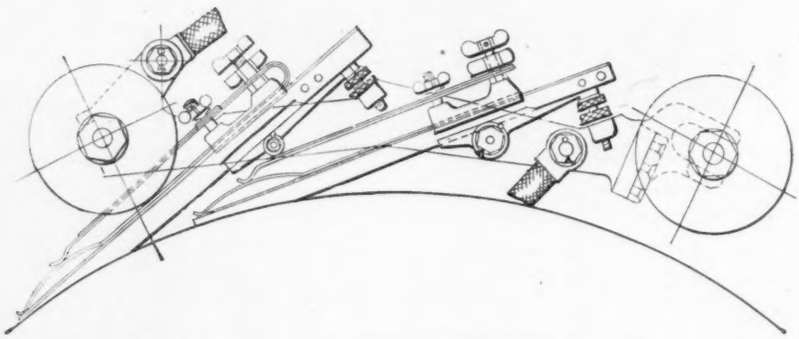


FIG. 13.—BRUSH HOLDER FOR SMALL MACHINE.

teristic of the acyclic generator renders it especially well suited to supplying energy to railway and elevator motors.

Two 500-kw generators are operating in parallel with each other and with other generators and the load is divided equally. These machines are used as three-wire generators with the neutral tapped off at the half-voltage point, no auxiliary apparatus being used with the generators. These generators, which supply energy to lamps and to elevator motors, are illustrated in Fig. 12.

All machines that have been in commercial operation thus far are shunt wound, although a compound-wound set is being built. The voltage regulation of a shunt-wound acyclic generator operating under motor and lamp load is much better than that of an ordinary shunt-wound, direct-current generator subjected to the sudden changes of the load. The reason for this performance lies in the fact that both the armature and the frame of the acyclic machine are solid castings, and hence the movement of the magnetic field is sluggish so that any change in voltage under sudden changes of load is very little affected by the change in armature reaction. A comparison of the voltage regulation of the above-mentioned 500-kw acyclic units and

commutator generators operating under the same load, and otherwise similar conditions, on the same system are shown in the charts of Figs. 14 and 15. Both types were operated as shunt-wound machines without automatic voltage regulation. The improved regulation of the acyclic units under sudden

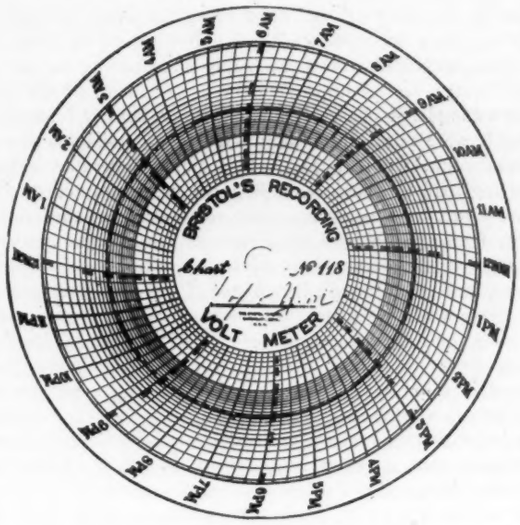


FIG. 14.—VOLTAGE REGULATION OF SHUNT-WOUND ACYCLIC GENERATOR.

changes of load are evident at a glance. No flicker of the lamps was noticeable, even when the elevator motor load was the most severe.

APPLICATION.

The field of application is in a general way conditioned more by the drive and the voltage than by the character of the service; that is, very small units can be built commercially only for low voltages, while for large units voltages higher than common

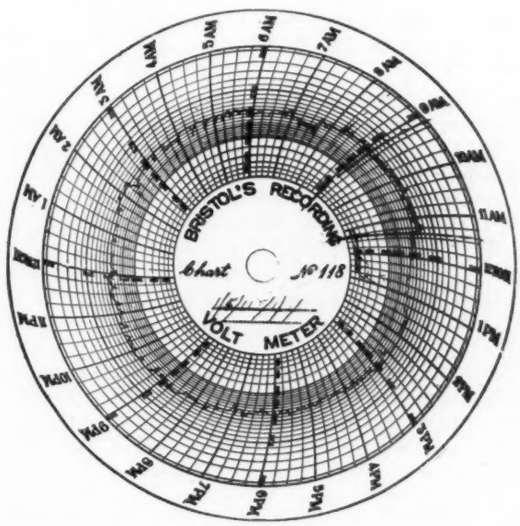


FIG. 15.—VOLTAGE REGULATION OF SHUNT-WOUND COMMUTATOR GENERATOR.

direct-current practice prescribes can readily be obtained. There are, however, other conditions which may be favorable to the design, such as the necessity for a wide range in voltage, or a high fly-wheel effect, etc. In any event, it is essential for the prime mover to be a high-speed machine, whether it be a steam turbine, a water wheel, or an electric motor.

A Method of Balancing the Load on and Improving the Power Factor of Three-Phase Systems.

BY A. A. RADTKE.

The necessity of balancing the loads on three-phase systems which distribute energy single or polyphase, or a combination of both, has undoubtedly at some time occupied the attention of all engineers operating such systems.

In systems where an unbalance occurs, the resulting poor regulation of voltage not only causes a general dissatisfaction among the customers and seriously affects the life of the lamps used upon it, but also incapacitates the generators to a considerable extent. To obviate this difficulty, the central-station manager has resorted to various means. If his system is such that single-phase feeders are used, the general practice has been to arrange the switchboard and buses so that any feeder can be connected to more than one phase of the bus, with the result that considerable freedom is gained in distributing equally the load which would otherwise unbalance the system. The cost of the bus construction has necessarily been increased by this practice as has also the switchboard itself. However, the advantage gained has warranted its use; moreover, the double bus allows greater latitude in repair and extension work than does the single bus.

It has also become the practice to install individual feeder regulators, either hand or automatically operated, of a size sufficient to overcome the voltage difference due to the unbalance. This arrangement likewise has resulted in a considerable increase in the cost of such an installation, and is not an entirely desirable method since it raises the individual feeder pressure by still further decreasing the e.m.f. impressed upon the buses.

Where, however, the feeders are of necessity three-phase, the problem of balancing becomes a more difficult one. In most instances it is not at all satisfactorily solved. The practice of central-station companies which have to meet this problem is to keep changing the arrangement of the feeder taps on the bus as the load varies in each district being supplied with energy. Such work must be done on a live bus, and hence it is not only expensive, but is likely to involve the entire service due to accident or careless work. In some cases the primaries are changed in such away as to redistribute the load.

Either of the above methods, however, is unsatisfactory, due to the character of the unbalance changing for the various portions of the day and week. In districts where lighting alone constitutes the load, these difficulties are of not much moment, but where motors of considerable size for elevators or other intermittent service form a considerable percentage of the load the constant variation causes an unbalance frequently of such a decided influence, particularly at the time of maximum, as to cause anxiety on the part of the operating engineer. In fact, the writer has seen cases where one phase of a feeder would be carrying 100 per cent overload during the peak, while the remaining phases would be carrying only a 25 per cent load. It is readily seen, therefore, that the output of a polyphase generator is frequently limited to its single-phase rating by the unequal distribution of the load. This conclusion likewise applies to the copper leading to the distributing points.

Intimately associated with the above problem is the one of the improvement of the power factor of such systems. In order to emphasize this point, the accompanying power-factor curves for such a system are given. It is readily seen that the losses in such a system are increased, due to the poor power factor during the greater portion of the day, and that it is constantly necessary to have a larger generating equipment connected to the system than would be required if the power factor were increased to unity. Moreover, the regulation of generators is rendered poorer by the low power factor. While at unity power a regulation of 8 per cent is common, at 70 per cent power factor the value is increased to 20 or 25 per cent. Taking as an

example the case given by C. W. Stone in a recent paper on "Power Factor Correction":

"If we assume a distance of 5 miles and a load of 1000 kw and desire to deliver this load at a potential of about 6000 volts with a power loss of 10 per cent, each conductor at unity power factor would have to have a section of 79,200 cm; at 90 per cent power factor, 97,416 cm, and at 60 per cent power factor, 220,176 cm; or, in other words, at the lower power factor of

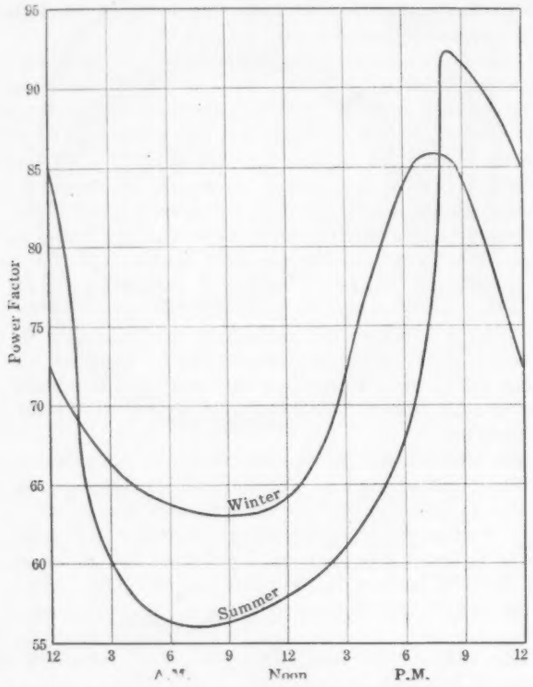


FIG. 1.—VARIATION OF POWER FACTOR THROUGHOUT THE 24 HOURS.

60 per cent the investment in copper alone would be nearly 2.8 times as much as at unity power factor. If the same size of wire were used at both unity and 60 per cent lagging power factor, the power loss would be about 2.8 times the loss at unity power factor, or about 28 per cent.

"If we assume a system with an inductive load of 1414 apparent kilowatts, the power load being 1000 kw, the power factor would be 70.7 per cent lagging and the wattless component would be 1000 kv-amp. By adding 500 kv-amp, leading, the apparent load would be reduced to 1120 kv-amp, or a saving of 1414 — 1120 = 294 kv-amp. If, however, 500 leading kv-amp more to be added it is apparent that only 1120-1000 kv-amp or 120 kv-amp would be saved, showing the greater value of the leading current when the power factor is low."

Transformers and the distribution copper are likewise reduced in service capacity by the poor power factor. The regulation of transformers is affected in the same manner as generators by this cause. Small lighting transformers having a regulation of 1 or 2 per cent at unity power factor will have about 4 or 5 per cent regulation at 70 per cent power factor.

The saving in copper in the line alone in this example by raising the power factor from 60 to 90 amounts to 1½ times the cost of synchronous condensers to effect the same purpose. If to this were added the additional saving in generator, transformer and regulator equipment, this amount would be several times the cost of the synchronous condenser.

The matter of balancing and power factor correction is particularly important at the time of the year at which the maximul load occurs, because it is for the load during this period that the entire equipment has to be purchased and installed. In the example shown by the curves of Fig. 1, where the peak occurs at 5:30 p. m. in the winter period, it is necessary to install an equipment at least 20 per cent in excess of the rating needed if it were possible to make the power factor unity.

In recognition of the foregoing difficulties, the following method of balancing the load and improving the power factor has been devised:

Three single-phase machines are connected to a shaft with armatures displaced from one another by 120 electrical-space degrees, as indicated in Fig. 2. The machines are so constructed that their field cores can be rotated either by hand or automatically, forward or backward from the initial position. If these machines are connected to the three-phase leads of a system a means is obtained of producing a balance on an unequally loaded system and of improving the power factor of the system.

For example, if phase *A* should become heavily loaded while *B* and *C* were relatively without load, it is possible to cause the machine connected to phase *A* to act as a generator, aiding in supplying load to phase *A*, while machines connected to phases *B* and *C* act as synchronous motors to drive it, thus drawing energy from the lightly loaded phases. In order to accomplish this result it is necessary to advance the position of the field core of machine connected to phase *A* until its pressure is in time-phase with the generator pressure on that phase, and at the same time allow machines connected to phase *B* and *C* to assume motor positions; that is, such that the counter e.m.fs. induced in them are behind the corresponding generator pressures of these phases.

In order that this means may take care of constantly varying conditions, such as exist in a district in which motors intermittently change the distribution and character of the load, a small motor is used to change the positions of the field cores of each of these machines so that as any one phase becomes heavily loaded, the motor connected to the machine on that phase moves the field core of the machine to the generating position. These pilot motors have their circuits closed and opened by relays in the main circuits.

The above arrangement also allows of the corrections of the power factor. At times when no unbalance exists the excitation can be so adjusted as to give unity power factor on the system. in this way decreasing the copper losses and the fixed charges on the excess copper, the generating and the transformer equipment.

The proper location for the balancing equipment in large systems is at the transformer substation. When placed here it

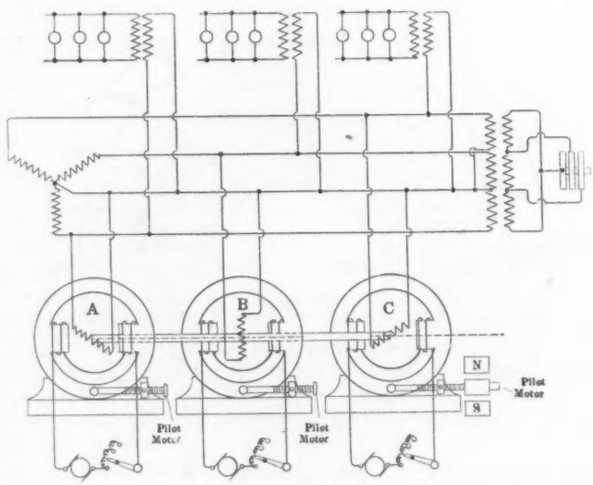


FIG. 2.—DIAGRAM OF METHOD OF BALANCING LOAD AND IMPROVING POWER FACTOR.

would not only simplify the bus and switchboard construction, but would decrease the percentage of required regulator equipment. It would also decrease the equipment of transformers, transmission copper and generators.

The cost of the balancing units would slightly exceed the saving of generators at the generating station, but would be much less than the same percentage of station cost.

An estimate of the saving due to such a balancing set at a

substation 5 miles from the station of the same rating and operating under the conditions outlined in the above-mentioned problem given in Mr. Stone's paper, would be as follows: Assume, first, that an unbalance of 25 per cent exists successively on the various phases. Increased generating and station equipment necessary:

250 kw at $125.00 per kw, including building, etc.	$31,250.00
Line copper at $0.22 per lb.	1,056.00
250 transformer kw installed.	2,500.00
	$34,806.00
Balancing set three 250-kw units.	11,000.00
Saving due to the balancing equipment.	$23,806.00

In this assumed condition no account is taken of the increased saving in the switchboard or the saving in the regulator equipment. Likewise the increase in the life of lamps, though difficult to calculate, would be a very appreciable item, as would also the saving in feeder regulator equipment and the elimination of the necessary change-over charges due to the changing of feeder taps as the load varies. The cost of the added switching equipment for the balancing set is more than offset by the saving in the feeder switching equipment.

With the growing preference for generation at the frequency of distribution the use of methods for improving the power factor of systems will become standard practice, and as pointed out in the present paper, a decided saving both in operating and in first cost can be effected, when the synchronous condensers can be used not only for improving the power factor, but also for balancing the loads on the several phases.

The Comparative Aging of Electric Sheet Steels.

BY T. S. ALLEN.

A great advancement has been made in the past few years in the manufacture of sheet steel for electrical purposes, namely, in reducing the hysteresis and eddy current loss and at the same time producing a material that is practically non-aging. Doubtless information concerning the comparative merits of the newer and the older steels will prove of interest at this time.

The following curves and data were compiled from tests made at the Cincinnati Works of the Allis-Chalmers Company on steel used in the manufacture of transformers, motors and generators.

These tests were made on standard electric sheet steel which contains a very small percentage of impurities and on a special steel alloy containing a high percentage of silicon. This special steel has an electrical resistance from three to four times that of the standard steel and is very much stiffer. When it is broken it shows a very crystalline fracture. Another interesting feature of this material is the very tough scale which, when the sample is bent, can be peeled off in a large flake, leaving the surface of the steel very light in color. This scale can be bent at right angles without being broken and is, to a large degree, magnetic.

The samples on which the aging tests were made were in the form of small transformers which were marked *A*, *B*, *C* and *D*. These transformers were built up of strips 1½ in. long to a height of about 3 in., with only one coil of 200 turns on each.

The tests were made by the standard wattmeter method. Transformers *A* and *B* were taken from the special steel, *C* and *D* from the standard steel; the steels of *A* and *C* were annealed, while the steels in *B* and *D* were tested just as they came from the mill.

After a test was made on each transformer, all of them were placed in an asbestos-lined box, which was heated by incandescent lamps, the temperature being held at 73 deg. C. From time to time they were taken out and retested. The conditions of each test were exactly the same, the meters and alternator being used for each test. Fig. 1 shows the results of this test in the form of curves with time as abscissas, and with watts loss per pound, at a density of 64,500 lines per square inch, and a frequency of 60 cycles per second as ordinates. The first point on curve *C* shows a loss of 1.55 watts per pound, which is about as good as can be obtained from standard annealed steel at this density and frequency. Comparing this with the first point on curve *A*, which is 0.925 watt per pound, for the special steel, the relation between the two shows the special

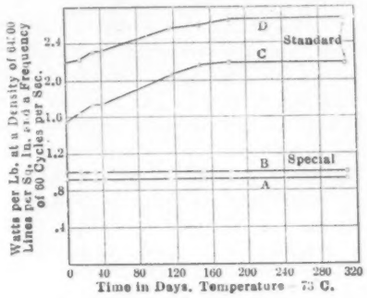


FIG. 1.—AGING CURVES OF SHEET STEEL.

steel to have a loss of about 60 per cent of that in the standard steel.

A glance at these curves will show at once the wide variation of the losses in the standard steel caused by annealing and aging, while with the special steel there exists a very stable condition in which there is no variation due to aging and only a slight decrease by annealing.

The chemical analyses of these steels show the following impurities expressed in per cent:

	Special. Per cent.	Standard. Per cent.
Carbon	.060	.040
Silicon	3.040	.010
Sulphur	.034	.045
Phosphorus	.051	.089
Manganese	.200	.260

From these data it will be noted that, with the exception of silicon, all of the impurities are approximately the same in the two steels.

In Fig. 2 is shown the relative magnetization curves of the two steels. The special steel has approximately the same reductivity as the standard; there is a slight variation around a density of 90,000 lines per square inch, but not enough to make any difference in the design of a machine to be built of this material.

From the results of these tests and the results of tests which have been published previously it is learned that silicon has

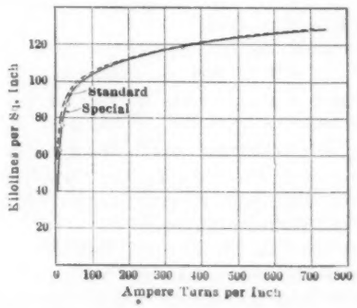


FIG. 2.—MAGNETIZATION CURVES OF SHEET STEEL.

played an important part in the manufacture of a non-aging steel with a low hysteresis and eddy current loss, thus enabling the designers of electrical apparatus to advance one more step toward higher efficiencies and lighter weights.

It is very probable that the advancement and perfection in the design of electrical apparatus in the future will be more through the manufacture of higher grades of steel than from any other source.

The Storage Battery for Web Printing-Press Control.

By S. H. Sharpsteen.

For temporary slow-speed work, 5 per cent of the maximum production speed is usually required by the large web press builders and foremen of the press rooms of large daily papers for paper threading and plating purposes.

Two hundred r.p.m. of the driving shaft of the press has been in many cases the maximum production speed advised by R. Hoe & Company for its quad presses. Ten r.p.m. is, therefore, the threading or make-ready speed. For the regular daily production one of the best-managed newspaper plants using R. Hoe & Company's quad web presses runs at 25 per cent below the maximum producing speed guaranteed by the makers. However, the driving and controlling apparatus are capable of giving the maximum speed in case it should be wanted. The plant is individual-motor driven and the speed variation is obtained by field control.

The production speeds of magazine web presses are usually very much lower than the production speeds of similar presses for newspaper work, while the threading speeds should be about the same.

A web printing press contains many parts that need careful adjustment and alignment, the importance of which demand a constant speed below that of the threading speed. A shaft slightly sprung, bad mesh of gear and pinion, or many other things about a large newspaper press may occur that could be detected much easier with a very low constant speed than with a jerky movement with power or intermittent slow speed produced by men pulling on a starting bar.

If a dial controller or some of its modifications, operated by hand, is used, each notch or point of the controller on which the press moves should give, as far as can be observed by the pressman, constant speed regardless of change in temperature, paper tension or friction. If it is required to operate the press on a certain point of the controller for some minutes the speed should remain constant from start to finish.

Where automatic controlling devices are installed and push buttons located about the press are used to operate the automatic controller any number of seconds that a push button may be held down should produce the same speed each time used in going ahead or slowing down.

Dashpots to limit speed of action of the automatic devices are undesirable, as they often change the time between the press starting and coming up to certain desired speeds thereby confusing the pressman when he is hurrying to print an edition.

As in the hand-control, each running point of the automatic controller should mean to the pressman a constant speed while the controller is at that point.

The average pressman is either in love with or at war with the press he uses. If he can get absolutely fixed low speeds for threading and plating, he has no fear of being hurt when putting paper into the machine, and he goes about his work with a feeling of contentment, but if the press is liable at any time to make a dash ahead during the threading process, the pressman moves about with a savage expression and acts as if he would like to wreck the equipment.

If the speeds are constant the employees will work about the large machine with tools while the equipments are moving slowly and will thus accomplish results that are surprising. When plates are being put on or changed they will use wrenches to tighten the bolts after the press has started, and they seem to know to a fraction of a second the time at their disposal.

At all speeds, from the lowest to the highest, in web newspaper and important magazine work the voltage at the brushes of the motor should remain constant regardless of varying load up to the point where the circuit breaker, or other automatic devices, open. Conditions of this kind bar the use of resistance remaining in the circuit with the armature while running. Web press manufacturers, managers and men supervising the machinery in large newspaper and magazine print shops realize the importance of control of this nature. It has often been promised, possibly by salesmen that did not understand the situation very well, but the promises have not been fulfilled.

Practically all systems of electrical control now installed on web presses constantly use resistance in circuit with the armatures for all speeds below the normal speed, or the speed of the motor that drives for production. Thus the operation of the whole press equipment contains an element of uncertainty which should not exist in a large web-press plant.

The accompanying illustration shows a method of control that uses no resistance in circuit with the armature. Let *A* represent the armature of a 120-volt motor, the shaft of which is belted or geared to the driving shaft of a single large web newspaper printing press. When the lever *H* of the controller is placed by hand on point 1 of the controller dial a circuit is closed through the cells 1 and 2 of the storage battery *D*, wire *W*, switch and switch jaws at *X* and *X'*, wire *W'*, brush *B*, armature *A*, brush *B'*, controller-lever brush *U*.

If the battery is of sufficient rating and the wiring has been properly done, there is a difference of potential of 4 volts for

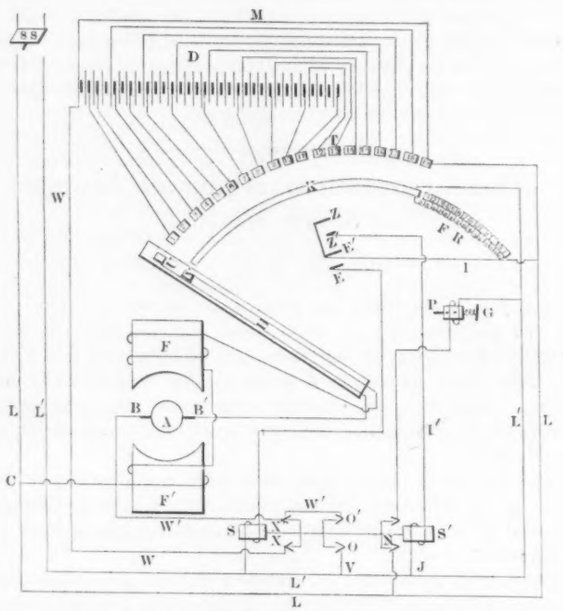


DIAGRAM OF CONNECTIONS FOR MOTOR CONTROL.

slow speed, and if the press is in good running condition the motor should drive it at about one-thirtieth of the maximum speed. This is an extremely low voltage on which to move a large press and motor. In actual practice 220, 230 or possibly 240 volts would be the normal value used instead of 120, which would require higher starting voltage. If the press started hard, using twice the running current, and the brushes and brush rigging were cheaply constructed, there might be a large percentage of the voltage lost in the brushes. The drop of voltage in the wiring would have to be carefully considered also, especially for the first controller step. It would be an easy matter with a hand controller to cut in more cells with the lever *H* until the press started, then, if the speed was too high, to cut out cells until the proper speed was obtained, but this is a bad arrangement especially where automatic controllers are used.

The next step adds 1 cell or 2 volts. At each succeeding step until point 5 is reached on the dial a pressure of 4 volts is added. Point 6 adds 6 volts. Each succeeding step until point 11 is reached adds 8 volts. On leaving point 11 the controller handle *H* closes a circuit across *Z* and *Z'* causing the solenoid *S'* to open the battery circuit *W* at *X* and *X'*, and at the same instant forcing the switch into the jaws *O* and *O'*, connecting the armature *A* into the dynamo circuit.

Assume that the armature speed is now up to one-half value, the line e.m.f. being 120 volts, the counter e.m.f. of the motor would be about 60 volts and is in circuit with the battery, so that 28 cells are opposite to the line in voltage. Point 12 thus adds about 8 volts above that of point 11, at the brushes of the motor. As the handle is placed on point 13 four more cells are cut out of circuit, giving the armature 8 volts additional pressure, and so on until point 19 is reached, when the line voltage is practically obtained at the brushes B and B'. The sliding contact piece Z of the solenoid circuit S' is connected with L through I, the other point Z' with L', through I', the coil of solenoid S' and the wire J.

The second or producing armature circuit starts at V on the wire L', passes through the switch and switch jaws at O and O', wire W', brush B, armature A, brush B', and when the lever brush U is on the point 12 of the dial, the whole battery D less the four right-hand cells, the wire M, point 19, which point is connected with the other wire L.

Assume that the motor is constructed for a two-to-one speed variation by inserting resistance in circuit with the field coils; accordingly, on reaching point 19 the equipment would be running at one-half speed and as the lever H passed over the small dial points at $F R$ the speed would be increased until point 14 of the field-circuit rheostat was reached, when the full speed ahead would be obtained.

The field circuit starts from the wire L at C, passes round the field magnets F' and F, through the brush Y in the lever H, the brass strip K and into the other wire L'.

After the brush Y commences to pass over the points in the dial of the field-circuit rheostat $F R$ the resistance of this rheostat will be added to that of the field circuit.

To insure the action of the solenoid S' and the opening of the battery circuit at X and X' before the lever H passes from point 11 to 12 on the controller dial a stop G or similar device could be used. A pin P of the stop being held into position through the controller front by a spring would prevent the lever H from coming into contact with point 12 on the dial unless the solenoid S' performed its function of opening the battery or starting circuit and closing the production or generator circuit and at the same time pulling down the pin P by throwing in the switch N.

The lever H would have to be constructed so that when it was moved from a production point toward the off position it would pass over the points Z and Z' without making contact with them, and make contact with E and E', causing the solenoid S to open the higher voltage or line circuit and close the battery circuit. E and E' would need to be protected from making electrical contact with the lever as it was moved in the "go-ahead" direction. A second device similar to G could be arranged to stop the lever H as it passed to the "off" position unless the solenoid S performed its function.

If the ordinary copper or carbon brush was used at U, excessive current would pass as a number of cells of battery were short-circuited at the instant that U touched on two adjacent blocks of the controller dial. The controller would have to be constructed so that the brush U would pass quickly from point to point on the dial independently of the operating handle as the handle was moved back and forth. The brush could be made with sufficient resistance inserted between sides to keep down this local current and not add a wasteful resistance to the armature circuit.

In the system described above there is no armature resistance to turn electrical energy into heat. When the battery is in circuit, if it is not furnishing energy to drive the press, it is being charged. While the battery is opposing the line current and is being charged there will be slightly more than 2 volts drop or counter pressure per cell.

One battery could be used for starting two or more presses, the controllers being interlocked so as to allow only one press to start at a time.

A good storage battery, if properly installed and cared for, would not depreciate very much if it were used exclusively for starting. This same battery if installed in a multiple of series, when not in use for operating presses, would serve for lighting and for small motor work at night by having switches for putting a sufficient number of cells in series to deliver the proper voltage.

The rheostat in circuit with armatures is probably the worst feature of electric motor drive for web presses. A 50-hp motor is not considered large in a web-press room, and much larger ones are often demanded for individual press drive. In almost all cases these motors use armature resistance to vary the speed. When the rheostat is to be used during long runs for production it is customary to provide for sufficient heat dissipation to prevent excessive temperature rises. At such times the motor speed is so near its normal value that the difference of potential is not very great at the terminals of the rheostat. When the motor is at one-half speed there is a large difference of potential at the rheostat terminals, the current being the same as at the higher speed, but the cross-section of the grids is very much reduced.

If the pressman allows the machine to run at half speed for some time the rheostat grids will often get red hot. The average business manager does not feel very comfortable when things of this kind occur in a department that is like a tinder box and on which he relies for his daily product.

If the rheostat grids of a 50-hp motor equipment were made of a sufficient size to permit every step to be used for running speed, or so that the controller lever could stand on any one point and let the press run indefinitely, these grids would weigh tons, occupy much valuable space and be dirt catchers.

Unfortunately, the rheostat grids cannot be enclosed as they must give off heat. Tucked in behind long rows of marble slabs in large press rooms they seem like inoffensive things, but they accumulate dust and dirt and get hot, a bad combination for such a place.

Gradually the printer will abandon the grid rheostat in circuit with the armature of press-drive equipments, and thereby save the electrical energy now dissipated in heating press rooms in the summer time, making it uncomfortable for employees, softening ink rollers and causing the use of energy to operate fans for forced ventilation.

Convenient Methods for Recovering Lost Winding Data.

BY GEORGE T. HANCHETT.

It sometimes happens that a machine is taken to a repair shop without armature or field winding, or perhaps both, with an order to rewind, and the department is at a loss to determine the necessary size of wire and turns to use in the armature or field circuit. This information, of course, can be determined by calculation by those who are able to make such calculations, but it is often the case that the work does not justify employing an engineer to make the necessary calculation and the machine type is obsolete and the original information is practically lost forever.

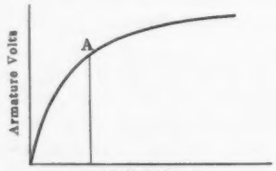
It is necessary as a major premise to determine the voltage and speed desired. These fix the permissible current output, for the customer may be safely told that if he insists on a certain voltage and speed he must accept whatever current output or input will result. These items being determined, suppose, first, the case of an intact field circuit, but the armature core devoid of winding.

Take some fine magnet wire—No. 20 is a convenient size—and wind the armature by hand one turn to a coil, employing the winding diagram that it is proposed to use in the completed machine. Little pains need be taken with the insulation of this wire, especially if the wire is double-cotton-covered, it being necessary perhaps to place empire cloth under the places where the wires turn sharp corners. It may perhaps be well as a preliminary measure to insulate the core for final performance

if it be a smooth-core armature, under which circumstances the temporary insulation of this trial winding may be omitted. The winding process can usually be completed in about half an hour.

The machine may now be assembled, the field coils subjected to the voltage at which the machine is to operate, and the armature may be driven as a dynamo, a low-reading voltmeter being placed across the brushes. The exact voltage and the exact speed of the machine should be noted. From the fact that the voltage thus obtained is directly proportional to the speed and to the number of armature conductors, the correct number of armature conductors required for commercial performance can at once be computed.

Suppose, for example, that the machine is to be a motor and that it has 60 armature slots and 60 commutator bars, that a temporary winding has been applied and the experiment made at a speed of 100 r.p.m., and that at this speed a potential of 0.4 volt has been obtained. Let us suppose that the desired operating e.m.f. is 110 volts and that the desired operating speed is 1000 r.p.m. The voltage per revolution will, therefore, be obtained by dividing the observed voltage by the number of revolutions, that is $\frac{0.4}{100} = 0.004$ volt. Dividing this value by the number of conductors, 60, 0.0000667 is obtained as the voltage per conductor per revolution. If this value be multiplied by the desired speed of 1000 r.p.m. the voltage per wire on the surface of the armature of the completed winding, or 0.0667, is obtained. If the machine is to be a motor and it is a small machine, the back e.m.f. of the motor may be estimated as 90 per cent of the applied e.m.f., and if the operating e.m.f. is to be 110 volts, the back e.m.f. of the motor should be 99 volts. Dividing 99 by the 0.0667, 1485 is obtained as the total



SATURATION CURVE.

number of conductors which must be divided among the 60 slots, or nearly 25 to a slot. It will, therefore, probably be best to select 12 turns to a coil, or 24 conductors to a slot.

The size of the wire is determined by the simple device of using as large a wire as possible and yet provide adequate insulation to protect it against the voltage at which it is to operate.

If the machine should be a dynamo, and the operating e.m.f. be 110 volts, it would be necessary to add 10 per cent to the operating e.m.f. in order to ascertain the generated voltage that the machine should have. The latter would be 121 volts, the remainder of the calculations would be the same as above, the results showing the need of a turn or two more per coil.

If the machine is larger a smaller percentage of armature drop should be assumed. Two per cent is probably a minimum value for the largest machine that will be encountered, and five per cent will be found applicable for motors over five and less than fifteen horse-power. Armature drop is greater than slow speed machines.

If the armature circuit is intact and the field winding information is missing, a simple experimental procedure, which is somewhat better known, may be employed. A set of spools having a known number of turns should be placed on the field cores and subjected to an external source of current; the excitation current should be measured with an accurate ammeter and the excitation should be increased up to a point that produces the desired performance, the machine being operated at its rated speed. Multiplying the current by the turns in the temporary coils will give the ampere-turns which the proper field coils must produce. If the machine is a series machine it is then necessary merely to divide the ampere-turns by the rated current of the machine to determine the number of turns which must be used; these should be wound upon the pole pieces by using a wire as large as possible and still allow room for adequate insulation. If it is a series machine another precaution must be observed. It must be remembered that the armature voltage of a series motor is less than the line voltage by the drop in the series coils, which varies from 2 to 10 per cent, according to the size of the machine, being smaller in the larger machines. Therefore, in the preliminary test if the machine is a motor, the operating armature voltage to produce the desired performance should be from 2 to 10 per cent less than the line voltage; if it is a dynamo the e.m.f. should be correspondingly greater.

If the machine is to be shunt wound, as is more often the case, the procedure is somewhat different. If the temperature conditions are not to be considered in the shunt machine the number of turns selected is not significant, the magnetization depending solely upon the gage of the wire which is employed, provided further that the dimensions of the spool are constant. In order properly to apply the date obtained by the test, determine from the finished dimensions of the bobbin the average length of turn in feet. Divide the total ampere-turns by the total number of bobbins in series, this giving the ampere-turns on a single bobbin. Divide the line voltage also by the total number of bobbins, giving the e.m.f. to be impressed on a single bobbin. If, now, the e.m.f. on a single bobbin is divided by the ampere-turns on a single bobbin, the result will be numerically equal to the resistance of a single turn, and as the length in feet of one turn is known, the resistance per foot of this turn can be computed and from this value the proper gage of wire can be readily selected from a wire table.

In the case of a shunt-wound machine it is not necessary to make any correction in the experimental performance as in the case of the series machine, for the power of the shunt coils appears in the form of added current taken from the mains or from the armature, as the case may be, and does not materially affect the voltage conditions. If the machine be a dynamo it is well to use a size of wire larger for the shunt-field winding than the calculations indicate in order to allow a margin for regulating.

If the machine comes to the shop without armature or field-circuit wire, and with only its performance known, it will be necessary to use a combination of the above methods. Place an experimental winding on the armature, this time sufficiently tight so that the armature can be operated at full rated speed. Place an experimental winding of a known number of turns upon the field cores, using an ammeter in circuit so that the ampere-turns can be noted. Then begin with a small excitation and gradually increase its value, noting the voltage at the armature and the amperes of excitation at every step until the excitation current has reached a value as high as the experimental coil will permit.

Make a plot of these above results, using armature voltage as ordinates and excitation amperes as abscissas. The diagram will be what is known as the saturation curve of the machine, and will be found to rise from the origin, increasing with the excitation, and finally to flatten out, as shown in the accompanying illustration. The proper excitation will be found at a point just below the knee of the curve, marked *A* on the diagram; knowing the ampere-turns that this excitation produces, the proper field current can be computed for either series or shunt connection as before, and knowing the armature voltage per conductor that is produced at this excitation the proper armature winding can also be calculated.

The above-described simple methods will in almost every case of ordinary repair-shop work abundantly suffice for determining the missing data and will save the expense of employing a dynamo designer. They are often resorted to in more elaborate form by dynamo designers themselves, who desire to obtain data concerning frames for which they wish to select windings.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Winchester, Mass., Street Lighting Rate Case.

R. E. Joslin, Esq., counsel for the town of Winchester, Mass., has requested the Board of Gas and Electric Light Commissioners to reopen the hearings upon the petition of the Board of Selectmen asking for a reduction in the street lighting rates charged the town by the Edison Electric Illuminating Company, of Boston. During the year ending June 30, 1907, the town had a contract with the company whereby the latter undertook to furnish, place and maintain arc and incandescent lamps, the number at the outset being about 45 arcs and 246 incandescents. The arc lamps were of the 6.6-amp alternating type, requiring an average energy of 422 watts, and the incandescents of the 25-cp size. The overhead system of distribution was employed. The town agreed to pay for 1600 hours burning each year at the rate of $75 for each arc and $15 for each incandescent. If the total number of incandescents or their equivalent (counting one arc as equal to five incandescents) exceeded 400, then all lamps in excess of 400 were to be at the rate of $65 per arc and $13 per incandescent lamp. For each hour burned in excess of 1600 per year, the town was to pay at the rate of 2 cents for arcs and 0.4 cent for incandescents per hour. Up to July 1, 1907, the lighting was on a moonlight schedule, and since that time, at the request of the town, the lamps have burned every night until 12:30 a. m. Since the expiration of the contract the town and the company have been unable to agree upon a new contract.

The company offered to renew the previous contract upon the same terms, save the substitution of 32-cp lamps for the 25-cp size. The company had meanwhile made a contract with the neighboring town of Arlington to supply it with street lights for a term of 20 years at the same rates and of the same types as offered to Winchester, but with a discount of 20 per cent on each monthly bill during the entire time, and offered to Winchester substantially the same price which it made to Arlington if it would execute a 20-year contract. Winchester claimed, however, that it was entitled to the prices and discounts named in the Arlington contract, and was unwilling to bind itself for more than a single year.

The company claimed that with a short-time contract there is an element of risk that the town might abandon the company's service and thus introduce an element of abnormal depreciation. The board in its finding did not consider this to be unlawful discrimination, but pointed out that if either party desired to present further evidence regarding the determination of a reasonable price for the Winchester conditions the hearing would upon request be reopened. No reduction in rates was ordered, but the board expressed willingness to receive further evidence if such should be forthcoming. It pointed out that the company's position is distinguishable from an attempt to impose as a condition precedent to obtaining a supply at all or at a price in excess of the regular rates, that a customer must agree to obtain his supply from any other source for a given period. It felt that a final decision should not be made without a thorough investigation of the question upon its merits independently of the prices made to Arlington and offered other municipalities in making long-term contracts.

The Grounding of Low-Potential Alternating-Current Circuits.

Mr. L. Clifford Anderson presented a paper at the recent annual convention of the Ohio Electric Light Association, held at Put-in-Bay, dealing with the advantages of grounding the low-potential secondary circuits of transformers and discussing the limiting voltage of grounded circuits. He remarked that whenever a high-potential primary conductor comes into electrical contact with a secondary conductor of an ungrounded secondary system the potential of the secondary conductor is raised to that of the primary conductor with which it is in contact. The contact of the two conductors may be due to a breaking down of the insulation between the primary and secondary coils of a transformer, or it may result from a cross of the primary and secondary wires either within or without the transformer.

The difference of potential between the earth and the primaries of an alternating-current system depends on the locations and resistances of the various intentional or unintentional primary grounds, and it may have any value between zero and the full primary voltage; hence the potential with reference to the earth of the crossed secondary will have a value somewhere between zero and the voltage of the primary circuit. The potentials of the other secondary conductors will be greater or less than this potential by an amount equal to the secondary voltage of the transformer.

Except in that very rare case where all of the primary grounds are confined to that leg of the primary circuit which is crossed with the secondary conductor, the secondary will be raised to a potential above the earth which will be dangerous to both property and human life. Usually the first warning of the high potential on the secondaries is either a fire or a severe shock to some one who touches some part of the electrical equipment in a building while his body is in electrical contact with the ground. Many well authenticated cases of death from this cause might be cited.

The preventive of this possible high potential of the secondaries is to permanently ground through a low-resistance connection some part of the low-potential wiring of each transformer or bank of transformers. With the low-potential secondaries thin-grounded none of the secondary conductors can have a greater difference of potential to the earth than the amount of the secondary voltage of the transformer. Transformers having their two secondary coils in series should be grounded at the point where the coils are connected together, while those having their secondary coils in parallel may be grounded at either end of the coils.

While satisfactory grounds are not always easy to secure, one of the following methods usually will be found available for this purpose:

(1) Connections to cast iron gas or water mains. These should be made by drilling and tapping the pipe and inserting a brass plug to which the ground wire may be soldered. (2) Connections to wrought iron gas or water service pipes. These should always be made on the street side of the meter. The connection may be made either by carefully cleaning the surface of the pipe and soldering the ground wire thereto, or by means of one of the several clamps for this purpose now upon the market. (3) Copper or galvanized iron plates buried in damp soil. (4) Galvanized iron or steel pipe driven into the ground at the base of a pole, and to which the ground wire may be soldered or attached by means of the clamps heretofore mentioned.

The last method is the one usually adopted, because it is cheapest and has proved quite satisfactory where the soil is damp.

In localities where the sub-soil is extremely dry and where connections cannot be made to the underground piping systems, it is sometimes necessary to make one ground secured in some damp spot serve for a number of transformers by running a wire from this one ground to a common point on the several transformer secondaries.

Recently a question has been raised as to the limiting voltage of the secondary circuits to be grounded. The committee of

the National Electric Light Association at the last convention of the association made a report which was accepted, in favor of grounding all alternating-current secondary circuits of 150 volts or less and prohibiting the grounding of secondary circuits when the potential to ground would exceed 150 volts, and requested that a rule to that effect be incorporated in the National Electrical Code by the board of underwriters. There are many who believe, however, that the limit of 150 volts is quite too low. A more rational limit would seem to be 250 volts. While it is true the large majority of secondary circuits would be included within the 150-volt limit, many would not. A limit of 250 volts from the ground to any part of the secondary circuit would cover practically all cases where this method of protection is applicable. Since a shock from 250 volts is not dangerous to human life, it is difficult to see the objection to making this the limiting e.m.f.

Experience with Series Luminous Arc Lamps at Toledo, Ohio.

Mr. C. R. McKay, of the Toledo Railways & Light Company, Toledo, Ohio, read a paper before the Ohio Electric Light Association at Put-in-Bay in August, at which he described an installation of 1670 luminous magnetite arc lamps in regular service for street lighting at Toledo, Ohio. All the street lighting in Toledo is now done by means of such lamps, which for the most part are spaced approximately 600 ft. apart in the residence and outlying districts of the city. In special cases, such as on Summit Street, the principal shopping street, two lamps are placed on each pole and the poles are spaced 80 ft. apart opposite to each other on each side of the street.

The energy is generated by 25-cycle, three-phase Curtis turbo-generators. To supply the arc lights 37 constant-current transformers wound for 2200 volts primary are installed, together with a corresponding number of mercury arc rectifiers and switchboard panels. Thirty-four of these rectifiers are of the air-cooled type, the air being supplied by either of two fans. Three of the rectifiers recently added are oil cooled. Six transformers and rectifier sets are placed in a substation in East Toledo. The operation of this substation, which is at a car house, is conducted by a car dispatcher without interfering with his ordinary duties.

All lines leave the power house in multiple-conductor lead-covered cables with 7/32-in. paper insulation on each conductor. After traversing the underground district in vitrified tile or cement-lined iron duct, the circuits continue overhead on ordinary construction with double petticoat glass insulators. No unusual line troubles have occurred either on the aerial, underground or submarine lines, although surges coincident with tube flashing have occasionally punctured temporary wiring between transformer secondaries and rectifiers.

The lamps are generally hung over the center of the street intersections, at a height approximately 25 ft., by means of suspension wires, and are lowered for trimming. The light in this type of lamp issues chiefly from the long arc itself, rather than from the positive crater. It is, therefore, quite sensitive to rupture by draughts of air unless thoroughly protected by windproof casing and tight globes. Early difficulties with the upper electrode have been remedied by using copper of large diameter. The life of the lower electrode has been increased from 110 to over 160 hours.

The luminous arc lamps in operation average from 320 to 324 watts per lamp, including line losses, as measured at the direct-current circuit terminals. The current is about 4 amp. They take 38 per cent less energy per lamp than the 7.5-amp alternating-current lamps they displace. The residents of East Toledo have given unmistakable testimony to the superior light given by the luminous arc as compared to the 7.5 amp enclosed carbon arc by objecting to the use of the latter during a temporary interruption of the other circuit.

The 1670 lamps, distributed over 37 circuits, are trimmed by three trimmers, each provided with a horse and buggy. About 1 per cent of the lamps are usually in the shop for adjustment or repairs. Figures given showed that the efficiency of the mercury rectifier sets measured from the alternating-current transformer primary to the terminals of the direct-current arc circuits is 89.8 per cent at full load and 84.3 at 74 per cent load. The power factor is 55 per cent at full load and 45 per cent at 74 per cent of full load. The manufacturers guarantee an average life of 400 hours for the rectifier tube, but the tubes in service have averaged 1436 hours' life.

Electric Flatirons in the Montpelier-Barre, Vermont, District.

The Consolidated Lighting Company, of the Montpelier and Barre district in central Vermont, has had a gratifying season with regard to the installation of electric flatirons. This company serves a population of about 28,000 in seven communities, and there are now on the circuits about 1050 electric irons, or one to each 27 inhabitants. Since the first of this year the company has added 131 irons to its load. Advertisements have been run in the daily press in the different towns served as late as July 1, the point emphasized being that 30 days' free trial would be allowed up to the month of July. The irons are sold at $3.50 each. They cost the lighting company more than $3.50, but it was deemed unwise to raise the price, the difference being charged to advertising.

In July the company ran an advertisement stating that it would give out the irons on a 30-days' trial during that month only. The reasons for this policy were that it had been found that in the past two years in putting irons out in the months of August and September the intention of the customers was in some cases to use them during the 30 warm days and return them when cooler weather set in, and also the intangible attraction of a time limit on a liberal sales offer. It seems that when the time for the 30-days' free trial has expired, not a few customers want the irons more than ever. About 20 per cent of the irons come back, but the company finds that if the iron comes back one year the chances are that it will be asked for by the same person the next year. A large number have been put out this year to people who tried them last year, but did not keep them. The means of many of the company's customers are limited, so that the failure to purchase an iron after trial does not necessarily indicate dissatisfaction.

Out of the 1050 irons in use about 1000 are 6-lb. units, and the balance are 3-, 5-, 7- and 8-lb. units. All are operated at the regular lighting rate of 10 cents per kw-hour. The company's peak load is about 3400 kw at the present time, and the load in the early part of the week is somewhat higher, usually, than in the latter, although it is difficult to determine how much of this is due to the flatiron service on Tuesday. Aside from uses of irons in homes and tailoring shops, several dressmakers have been much pleased with the irons, and clothing stores that handle ladies' suits find them convenient. There are also some large tailoring irons in other shops. When the company places an iron it is careful to give the purchaser thorough instruction in its use. Few of the cartridges burn out, the greatest trouble being with the cord and terminal connection, which is sometimes broken through dropping of the iron or by rough handling.

Aside from the advertising of the irons in the daily press, irons have been shown in the company's office window in the central business district of each city served, with an attractive sign reading as follows:

"Madam: Our customers are using 1042 electric flatirons, all giving satisfaction. We want to make it 1200. Let us send you one. Cost only $3.50, and cheapest method of ironing—2.5 cents per hour."

It is difficult to trace inquiries that come from any one of the various means of advertising irons, but there is little doubt that the company's efforts to bring the irons before the public have been prominent in securing the business. The local gas company does not attempt to do flatiron canvassing or exploiting to any noticeable degree. The company has had no complaints

that the irons burn the goods upon which they are worked; the more even heat being an advantage in comparison with gas.

The cost of using electric and gas irons in the territory is about 2.5 cents per hour with electricity and 2.88 cents with gas at the prevailing rate of $1.60 per 1000 cu. ft. An ordinary gas-stove burner, such as would be used domestically, consumes about 18 cu. ft. of gas per hour. While it is true that an electric iron uses 500 watts, the power can be shut of for one-third of the total time while ironing. Under these conditions gas is cheaper than coal, and electricity is more economical than gas to the extent of about 0.38 cent per hour of service. There is no question that more work can be done with the electric iron, and in the summer months the difference in comfort is a strong feature. During the fall some advertising will be done to promote the use of the irons in the winter months. The customers in the past have generally placed their irons on the shelf at the end of the summer. The company serves a large number of working people who are very careful of their energy consumption, and for several months in the summer these persons do not use over the minimum charge of $1. The consumption would be less if it were not for the flatiron. Therefore, the customer is much more satisfied to use enough energy to raise the bill to the $1 mark or a few cents above it. Mr. James E. Davidson, general manager of the company, estimates that the earnings from the flatiron business average about 70 cents per flatiron per month during the summer months. There is no doubt from the experience of the company that the electric flatiron is a valuable promoter of other uses of electricity.

The Effect of the Tungsten Lamp Upon Electric Lighting.

By L. P. Sawyer.

The advent of the tungsten lamp upon the market has placed at the service of the users of electric light the most commercially successful illuminant that has so far been developed. The aim of scientists has been, since the introduction of the carbon filament lamp, to create a light source which would, in the point of efficiency, broaden the field of electric lighting. The culmination of these investigations has, up to the present time, been reached with the tungsten metal filament lamp. How soon this newest commercial product will, in the process of evolution, be replaced by some other more efficient lamp, the future alone can tell. Experimenters are never satisfied with their efforts, and the gratifying results obtained with still other rare minerals, when used as incandescent lamp filaments, lead us to believe that it will be but a very few years before the present system of incandescent lamp lighting will be radically changed.

The aim hitherto in the lighting industry has been to obtain an illuminant of a maximum efficiency and the goal, although still in the distance, is very much nearer than it was a decade ago. Instead of being satisfied with what has gone before, we are impressed with the fact that the light which was formerly considered sufficient and satisfactory for all needs is rapidly being replaced by the new illuminant.

The commercial development of so-called high efficiency lighting units has caused the attention of the manufacturers of various illuminants, such as the Nernst, Gem, tantalum and divers forms of arc and vapor lamps, to be turned away for the moment from the question of efficiency, and directed toward the uses, color values and quality of light of these light sources. This diversion has been of the utmost gain for the user of electric light. The investigations of men who are in a position to judge correctly from many specific cases at hand were immediately turned toward the problem of securing data upon which to base principles of proper lighting, or, in a word, illumination.

The opportunities offered by the opening of this new field has made famous, within the span of but few years, the pioneers in its development. Up to the time that the tungsten lamp was placed upon the market, the electric lighting business, from the standpoint of proper illumination, was merely "in its infancy." The high, and in some cases prohibitive, cost of installation and operation, together with a lack of light quality and efficiency of high candle-power sources, did not have the proper tendency toward the establishment of a true standard of illumination. The birth of the Gem and tantalum high candle-power units marked a great change for the better. At one stroke, the efficiency and light quality of electric lighting were bettered, and the possibilities of single unit illumination became apparent.

It was during this period of development that the value of reflecting and diffusing reflectors was made known. The high intrinsic brilliancy of the new filaments, together with their light distribution, made necessary the use of some means whereby the light radiation could be directed where it would be the most useful and meet given requirements. To gain the above end, scientific requirements had to be met. The old white enameled cone and the flat glass plate had served their purpose. Glasware of various shapes and sizes was evolved which had more or less absorption. In this case, as in that of the lamp, the climax has been reached in the most modern glassware, which employs one of the well-known principles of refraction and reflection to distribute scientifically the light rather than to simply reflect it, in order to give an even illumination.

It is of interest to note that the initial discovery of the metal incandescent lamp was made in this country. The final commercial perfection of the metal filament remained, however, to be done in Europe. The manufacturers of this country were not slow to undertake the new processes of developing the tungsten metallic filament, and the gratifying results speak for themselves. In the case of reflectors, the tables were turned. The original prismatic reflectors were brought from Europe, and the enterprising American has perfected the processes of manufacture.

To appreciate the wonderful progress which the tungsten lamp has made toward correct illumination, we have but to look over any lighting circuit in this country. Central station men have been quick to see the possibilities of obtaining new business with the aid of this modern lamp. The electric lighting business has ceased to show a decrease in revenue, due to the smaller amount of current required to operate the tungsten lamp. The reason for this is seen in the illuminating education which the active central station managers have offered to users of light.

The tungsten lamp has begun to replace many other light sources, interior as well as exterior illumination conditions being met by the new lamp. In the case of the former, the high brilliancy and color of the light make possible the adoption of more delicate and pleasing color effects than have ever before been reached. As an example of this, installations of the new illuminant in art galleries have given the greatest satisfaction. This may be taken as the most extreme case where the color shading is of the greatest importance. Interior decorators do not, as heretofore, have to resort to the deeper shades of color in order to produce good effects. On the other hand, more importance is given to the proper placing of the light in order to produce more harmonious results. The correct principles of illumination are being developed as an art instead of remaining as formerly, mere details of a lighting scheme.

The benefits to store-keepers by the use of the tungsten lamp are appreciated only from examples which could be cited. The well-lighted establishment advertises itself to the passer-by. The haberdasher, the tailor, the jeweler, as well as all other merchants who find light a necessity in order to display their goods, appreciate quickly the benefits to be derived from the new light, when it is properly installed.

Slowly, but surely, the tungsten lamp is crowding out the use of the open and closed types of arc which have been used for street lighting. Installations, all over the country, are rapidly springing up, thereby showing the diversity of uses to which the new lamp can be put. Business thoroughfares which are thus brilliantly lighted are an artistic addition to any

town, and at the same time afford the best kind of an advertisement to the merchants located thereon.

I await with great expectation the results which are to be expected from the work of the many central station men and illuminating engineers who are so deeply interested in the electric lighting business. The field has been made by the tungsten lamp and it only awaits the proper development.

Industrial Power Business from a Central Station Viewpoint.

By W. F. Lloyd.

In a great many cities and towns there is a large number of manufacturing establishments depending upon their isolated power plants for the operation of their machinery, a great majority of which are depending upon one engine and the skill of the attendant for the entire production of the establishment.

It is evident that great economies would be effected if all of these individual power plants were combined in one large electric generating station, managed by men who have made a life study of the generation and distribution of energy, and operated by men especially skilled in this particular line of work. The equal division of the economies effected would mean a handsome profit for the manufacturers, as well as for the central station company.

In several instances a systematic canvass has been made by central station companies among the manufacturing establishments in certain localities, the results of which have been very satisfactory, not only in the way of immediate business, but also by securing a complete record of the industrial situation throughout an entire territory.

The best results seem to have been obtained by employing canvassers with some little knowledge of engineering practice, who were not expected to interest the factory owner beyond the point of securing the data necessary for their report to the commercial engineering department of the central station company.

The canvasser should be required to secure information upon the following points:

Name
Address
Business
Person to see
Present form of motive equipment
Present form of lighting
Engine rating — Number of units
Boiler rating — Number of units
Pumps other than boiler feed
Approximate age of equipment
Is engine loaded to its rating?
Is present equipment giving trouble in any way?
Engine and boiler room labor consists of
Could engine and boiler room labor be eliminated upon the introduction of central station service?
If not, why?
If electric generator is used, give voltage and rating. Also the purpose for which it is used.
Is exhaust steam used in the manufacturing process? If so, for what purpose and approximately what proportion of boiler equipment is required for this purpose.
Hours per week plant is operated
Is plant ever operated overtime?
Is energy supplied to tenants?
Are any alterations or additions contemplated?

The canvasser should use the argument that the central station company desires the above information for the purpose of determining whether it can be of any service to the owner in effecting greater economy in the operation of his mill. The reports should be carefully analyzed by a commercial engineer, and such cases as would indicate possible business being then turned over to a power salesman; the reports on cases apparently hopeless should be filed and indexed for future use.

It is a recognized fact among central-station men that the industrial power burners require special treatment on account of the engineering features involved. Commercial engineering departments have been organized by a number of central-station companies to encourage the use of their product in the manufacturing establishments in their respective territories and to assist the general solicitors of the company in securing this desirable class of business. That the business is desirable is evident when we consider that it enables one to make the station and line equipment productive during the time when only a very small percentage of this equipment can be utilized in producing energy for lighting purposes; while in strictly industrial motor business the energy consumption in kw-hours per year per kilowatt connected is greater than in any other form of central station load (electric heating being classed as an industrial load), and consequently less station and line equipment is tied up for a given output of energy.

It might be said at the start that it is an impossibility to follow any set rule in the handling of power propositions, each case requiring special analysis and treatment. There is one thing, however, that applies to all cases, and that is the importance of getting the prospective customer sufficiently interested to entertain a proposition from the central station. After this has been done, it is a simple matter to convince him of the necessity of establishing some basis on which to estimate the probable energy consumption in the event of equipping his mill or factory with motor drive; any figures quoted without a foundation only engender a feeling of distrust, and unless one can gain the confidence of the man with whom he is dealing he has little chance of obtaining the business.

There are a number of cases in which it is not necessary or desirable to make an elaborate engine or motor test, especially in plants where the equipment rating involved does not exceed 20 or 25 hp. In such cases it has been found desirable to show the prospective customer just what the consumption is in similar plants in actual operation, indicating to him just what is known to be the average consumption of energy per horse-power connected in his particular line of business. This method gives an estimating basis that appeals to a man as being very practical, and if one can cite a case in his neighborhood it is still more convincing. Care should be taken, however, to indicate to him that there is no way of ascertaining with absolute accuracy just what his energy consumption will be, as this will be governed by the amount of business that he does, the consumption rising and falling with the production of his plant. The latter is another argument in favor of the central-station service, as the cost of steam or gas power does not fall off in the same proportion to the production, on account of the fixed charges and heavy constant friction load of a steam or gas engine plant.

Consider now the question of the larger motor business where it is not only desirable but necessary to enter into the details of all phases of the proportion.

Take, as an example, a mill that is being driven at present by, say, a 500-hp steam-engine equipment. Generally the first step would be to ascertain the actual horse-power developed by the engine by means of the ordinary indicator, readings being taken to determine the power needed to drive the shafting or friction load alone, the average working load and the maximum load of the mill. Wherever possible these conditions should be noted for each floor or section of the plant, in order to assist in determining the proper size of motors to be used. Where the load is a very fluctuating one, such as in machine-tool or other metal-working shops, readings should be taken at 15-minute intervals over the entire working day of 10 hours, the average of all these readings being assumed as the average working load of the plant. A sketch of the shafting and machinery layout should then be made to assist in deciding upon the proper distribution of motors throughout the plant, and to determine how much of the friction load can be eliminated by the motor drive. An estimate of the probable energy consumption should be then made, allowing for whatever friction load can be eliminated, and taking into consideration the motor efficiencies.

To better illustrate these various steps in handling a proposition of this character a specific case has been selected as a fair

example of the points involved. The case in question is the plant of an estate in one of our large cities. Floor space in this property is rented to various tenants for light manufacturing purposes, mechanical energy being furnished by the estate at a certain rate per horse-power per year.

Prior to May 1, 1907, mechanical energy was supplied by a 100-hp steam engine, which arrangement necessitated long lines of shafting and belting to reach the various tenants throughout the building, with consequent waste of energy, due to the heavy friction load. At the present time the steam engine has been disposed of and the entire load is carried on central station service, all wasteful line shafting and belting have been removed and each tenant is provided with a motor belted direct to his machinery; a meter installed at each motor records the actual energy consumed by each tenant, thereby giving the estate an accurate basis on which to distribute the charges for electrical energy.

Prior to the installation of motor drives the steam plant was run at a loss. Under the present arrangement a profit is made by the estate upon the energy supply without increasing the rental charge to the tenants; moreover, considerable valuable floor space was made available for rental purposes by the removal of the steam engine and useless shafting and belting. The motor installation consists of eight motors ranging in rating from 3 to 10 hp, the average being 5.7 hp. The load factor of the entire installation is approximately 50 per cent.

The prospect of obtaining the above customer was brought to the attention of the central-station company with which the writer was connected during a systematic canvass in the fall of 1906; the opening made by the canvasser was immediately followed up and permission was secured to make tests and get the data necessary for formulating a proposition.

The first step in this case was to make a drawing showing the general arrangement of the transmitting machinery and the location of the various groups of machinery to be driven. This drawing served a triple service in acting as a guide in making the engine test by showing what shafting and belting could be eliminated and what section could be motor driven; it was of great assistance in determining the most advantageous manner of motoring the plant, and it afforded a strong argument in presenting the central-station proposition by showing graphically the saving in energy and maintenance expense that could be effected by the elimination of a mass of wasteful shafting and belting and rendering floor space available for rental.

The next step was to place an indicator on the steam engine to determine the proper sizes of motors and to determine the probable consumption of energy in the event of the central station proposition being accepted. With this information it was a simple matter to make deductions and formulate a proposition. It might be said that one of the strongest points in securing this business was the confidence inspired in the mind of the prospective customer by the thorough manner in which the investigation was made, and upon which the central-station proposition was based. It is not meant by this statement that it is considered good policy always to discuss a mass of details with a prospective customer. Nine out of 10 men are not interested in these minor details as long as they are confident that a record of actual conditions has been secured and that the proposition has been based on these conditions.

It will be noted from the statement just made that the investigations are made mainly with a view to determining the two most important points involved in the central-station proposition, namely, the combined rating of the motors necessary to drive the machinery and the probable consumption of energy to operate the plant.

There is another point that has not been touched upon and which is important in some cases, namely, the question of heating the building in the event of shutting down a steam engine.

As this can be done at low boiler pressure, not requiring the services of a licensed engineer, and is only of five months' duration in the majority of cases, it is not found to be a very serious obstacle; but where close figuring is necessary and a few dollars may swing the case one way or the other, a heating estimate is got up based upon the cubical contents of the building, its exposure, number of windows, temperature to be maintained, etc., which enables one to tell very closely what will be the consumption and cost of coal in heating the building, to which is added the labor and whatever other costs are involved.

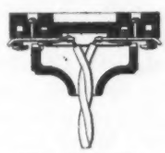
It is therefore apparent that to arrive at the total cost of operating the plant in the event of the introduction of central-station service, this heating figure must be added to the cost of current supply, which gives the figure in competition with engine plant cost.

A subsequent article will deal with the analysis of isolated power plant costs and their relation to central-station service.

INTERIOR WIRING AND ILLUMINATION

Cord Terminal.

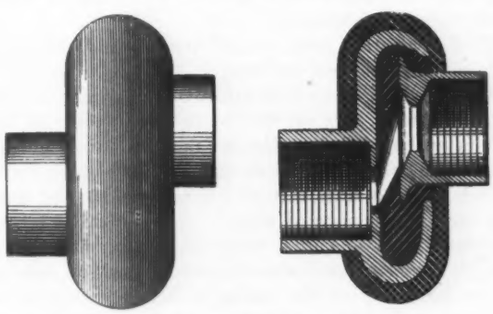
The accompanying illustration shows a cord terminal or rosette for which a patent was granted Sept. 1 to Frederick A. Swan, of Cliftondale, Mass. The specifications of the patent states that in the case of electrical fittings, such as rosettes, lamp-sockets, outlet boxes, etc., in which the conducting wires are connected to terminals or terminal plates by being passed under the heads of binding screws or nuts, the terminal answers so far as making a good electrical connection is concerned, yet if the conducting wires are so located that they are subjected to any strain, they are apt to be pulled from under or away from the binding screws or nuts, thus breaking the electrical connection. The object of the device patented is to provide a form of terminal for electrical fittings to which the conducting wire may be connected in such way that it will be impossible for the wire to be pulled from under the binding screw or nut by any strain thereon.



CORD TERMINAL.

Insulating Coupling.

The insulating coupling shown in the illustration herewith, for which a patent was granted Sept. 1 to Homer Ashbaugh, of Indianapolis, Ind., has the opening on a side eccentric to the other opening. The object of the device, as stated by the inventor, is to enable a workman to place a number of hanging fixtures in a large hall in exact alignment, to properly center a hanging fixture that is slightly off the center of an apartment, and to overcome the difficulty and make a finished job where there is a number of brackets in a room or hall and the outlets are slightly out of horizontal alignment.



INSULATING COUPLING.

Illumination Inspection.

By Albert J. Marshall.

Now that the subject of illuminating engineering is being generally taken up by the public at large, a good end can be served by bringing to the attention of the users of artificial light the desirability of being sure that their proposed lighting installations will be correct in all details when installed.

It can be assumed that most central stations and gas companies are agreed that it is highly desirable to have satisfied customers on their books. In fact, this should be and is in many instances the object toward which all such companies are striving. One way to obtain and retain such customers is to assure them that their interests will be fully protected, thus gaining their confidence by giving them desirable service; and when confidence is thus obtained the customers will accept the suggestions of the central stations and gas companies as final. There are, of course, many ways and means to which the central stations and gas companies can resort to accomplish this desirable condition of affairs, but only one such point will here be taken up.

When it is reported that a store, building, etc., is about to be built it is usually customary for the central station or gas company to have a solicitor call to see if he can interest the owner or prospective tenant of such building or store in using the service which his company supplies. When the solicitor has brought a prospective consumer around to the point where he is about to consider seriously signing a contract he frequently will ask how much light is necessary for his place of business or residence. It is generally at this vital point that we find so many solicitors—solicitors who are ofttimes not qualified to handle a simple lighting installation—making a grave error, which generally offsets the good work which he may have done in gaining the attention and interest of the prospective customer by stating offhand the character, number and location of the lighting equipment. As a consequence, the number of lamps and their equipment allotted for the space may not be sufficient for proper illumination. At other times more are allowed than is necessary. Once in a while the solicitor will happen to guess right, but this is not the rule. Often the competitive lighting system is installed. The consumer is either going to be pleased or displeased with the lighting installation. If he is pleased, all well and good. If not, he is going to be a source of complaint for an indefinite period of time. The central station or gas company has to bear the onus.

If the solicitor employed by a central station or gas company is not capable of assimilating the knowledge which is necessary to intelligently carry out the work intrusted to him, or not willing to do so, and it is found that the desirable type of solicitor cannot be employed for the salary which is being paid to the incompetent solicitor—salaries of solicitors, as a rule, are generally smaller than should be paid for this important work—the central station or gas company should obtain the services of solicitors who can and will acquaint themselves with the necessary knowledge.

While I grant that many central stations and gas companies are doing a great deal to educate their solicitors, in many instances providing them with information through the medium of lectures, books, etc., yet they seem to lose sight of the fact that it is well nigh impossible for the class of men that they ofttimes employ to get very much value from such assistance. I do not mean to state that all central stations and gas companies employ only men of meagre ability, because I have met many really good solicitors, men that any company could and should be proud of, and men that some day will have a real voice in the policy of the company, yet I do say that, as a whole, the quality of the solicitor is below what it should be and that central stations and gas companies could well afford to employ a better class of men, thus protecting and assisting the company as a whole.

Looking at the subject from another point of view, the contractor for wiring or piping frequently subordinates almost everything to his part of the work, namely, the running of wires and pipes. These contractors are satisfied, as a rule, to do their work so that it will pass insurance inspection, giving little or no thought to the real use to which the work will be put, namely, for illuminating a given space. They often place outlets where fancy directs, with no thought as to desirable illumination; one is often led to believe, after looking at such work, that the outlets were put there only to afford the contractor the greatest profit and not for the purpose of proper illumination. Realizing that this condition of affairs does exist, we can readily see that it is necessary to eliminate such practice, and the question naturally arises, How can the desirable change be brought about?

When use is made of electricity for producing artificial light in a building or space, wiring is done to convey the current to the light source, and an inspection is made of such wiring to see that it is installed in accordance with the rules of the underwriters. This inspection eliminates the possibility of fire due to imperfect wiring, and a central station, as a rule, will not connect up wiring with its meters until it has received a certificate from the underwriters showing that all wiring is done in accordance with the underwriters' rules. Could not the central station go a step further, especially in some localities, and have an inspection made by some one who understood illuminating principles of the arrangement of the outlets and their equipment before they would furnish current? Of course, such a course is revolutionary in character and one which would require much diplomacy to follow, in order to prevent any ill-feeling on the part of the public, which might feel that the central station had simply its own interest in mind when they assumed such an attitude. But if such work were handled properly there is reason to believe that the public would understand the motive that prompted the action.

I do not think that it would be advisable for the central station to attempt to dictate to the public in the matter and say that it would not supply current unless this and that were done; but I do think that the defects of a lighting system should be pointed out to the prospective customer before the current was supplied, such criticism being made in the form of a written report, either delivered by an employee of the company and receipted for by the proper party or else sent by registered mail. Then if after using the system the consumer should make a complaint which has a relation to the report made by the lighting company a copy of the latter could be shown him. I think that this would produce the desired effect and eliminate much useless waste of time, energy and money. There are some localities where there is but one gas or one electric company in the city or town, and in such a case, provided that the company employed proper methods, it would be but a short time before the public would become accustomed to such a policy and would accept it in the same manner that wiring inspection is now received, besides giving the lighting company credit for such valued assistance.

The central station, gas company and contractor could, without any great expense, employ a man, or men if necessary, who would familiarize himself with such methods as should be employed in the ordinary lighting installation, so that it would not be necessary to consult with men of greater knowledge on any other than the more complicated systems, or those in which the esthetic side was of importance. When work of a finer nature could not be properly handled by the local man it would be possible for the lighting company to call to the attention of the prospective customer that it was desirable to have the lighting system for his place designed by some one who could give him the effect that he desired. The names of recognized competent illuminating engineers who do designing and consulting work could then be submitted to the prospective customer and he could communicate with them directly or through the medium of the central station, gas company or contractor, the prospective customer paying for the services of the illuminating engineer, such services, as a rule, being reasonable in cost.

Inasmuch as the central station or gas company is generally blamed for most all defects in the average lighting system,

especially with reference to the size of its consumers' bills, I feel that it is necessary, in order to protect their interests, to come into closer relationship with customers, much closer, in fact, than is usually the practice.

If the central station or gas company finds that a contractor is honest and is displaying the necessary intelligence in his work, then it is reasonable and desirable for it to give to such contractor hearty co-operation; but if, on the other hand, a contractor is all for self and is not giving the consumer or prospective customer the consideration necessary, then I feel that it is desirable for the central station and gas company to point out to the contractor where he could improve his work. If such suggestions are gracefully received and the contractor shows that he wishes to do the proper thing, then he should receive the friendly support of the central station or gas company. But if he should not co-operate along proper lines, then it is only reasonable for the gas and electric interests not only to take away any friendly support, but to do all in its power to show the public at large the type of man with which they are dealing and in this way place the blame where it rightly belongs. It is not only just but necessary that the central station or gas company should do all in its power to protect its interests, and much greater care must be exercised in accomplishing this end in their work than in most any other class of business in existence.

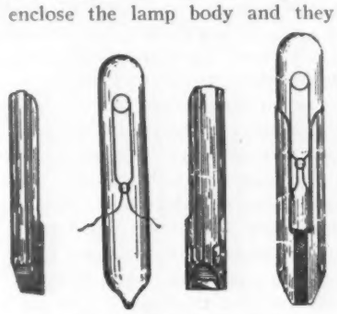
The central station or gas company manufactures current or gas, we will say, for the production of artificial light. Such current and gas are sold direct to the consumer. Current and gas thus sold are generally used through mediums which may have been placed on the consumer's premises by some contractor who did not have the consumers', central station or gas company interests at heart. When this current and gas are used in a manner not calculated to give desirable results we often find that the consumer comes back on the central station or gas company with a complaint. It is seldom, if ever, that the consumer goes first to the contractor or other person who may have been responsible for his lighting system with his complaint. In ninety-nine cases out of a hundred it is the central station or gas company which receives the blunt of such complaints, when in the majority of cases it is only to blame in that it did not see that the lighting system was correctly designed and executed. It seems an injustice for the central station or gas company to have to maintain a department to see that a contractor does his work properly, but surely this arrangement is much better than to maintain a complaint department, which seldom eliminates the cause of the evil; besides, the evil often lasts for a long period of time and is an endless cause of ill-feeling. With proper inspection there would be no cause for the evil. It would only be a matter of a reasonably short period of time when the good example set by intelligent inspection on the part of the central station or gas company would materially lessen the need of complaints to the work executed by the contractor. Therefore, the work of the illuminating inspection department would probably decrease with the increased volume of business done by the lighting company, while the complaint department seems to increase as fast as, if not faster than, the company gains business. This is another reason for creating such a department and subsequently doing away with the undesirable complaint department, in so far as lighting is concerned.

In closing, let us compare a central station or gas company with a company which deals in raw cotton, for instance. Such a company will often sell its raw product to the manufacturer, who will, from such product, produce cotton goods, which in turn may be sold to a dealer and then to the consumer. If the consumer should buy a piece of finished cotton material and find that it did not give satisfaction, and that it was reasonable to bring the fault to the attention of some one, he invariably would see the person from whom he purchased the material and would not go over the dealer's head to the company who sold the cotton in the raw state. This method of procedure in the business world is almost universal, with the possible exception of the central station or gas company, in which case most all complaints are passed over the heads of the person responsible. I contend that it is only just that if the electric and gas interests must receive these complaints, that they should also be in a position to eliminate the possibility of their cause, and one of the best means of elimination is co-operation with consumers and establishing confidence through correct application of illuminating engineering principles. Such a course will unquestionably be of assistance in accomplishing a desirable end.

New Telephone Patents.

SWITCHBOARD LAMP.

The illustration shows a form of switchboard lamp patented by W. W. Dean and assigned to the Kellogg Switchboard & Supply Company. The novelty lies in the terminals and their method of attachment. The terminals are formed of sheet metal as shown at the left and right. The tops are cylindrical to enclose the lamp body and they carry ridges



DEAN TELEPHONE LAMP.

longitudinally so as to provide a proper surface for the socket spring to bear upon and prevent turning in the socket. The lower end is turned outward so that the two terminals will form a sort of box with a wedge-shaped end. This box is filled with insulating cement which holds the terminals securely in place and to the lamp. The wedge shaped ends facilitate the placing of the lamp between the socket springs.

TELEPHONE SET FOR NAVY USE.

When the telephone is used for transmitting readings in range finding where there is likelihood of great noise and disturbance, a set must be resorted to specially designed for convenience and with a view to overcoming the effects of disturbance.

Mr. A. M. Cobb, of Lynn, Mass., has obtained patents for such a set. Two receivers are used. These are of the head pattern and are placed within leather containers, whose flexible projecting walls come in contact with the user's head and face and screen the ears. The receivers are held in place by an adjustable over-head strap, adjustable backhead strap and a chin strap. The transmitter is mounted within a V-shaped holder, the legs of which are secured by universal joints to the receivers. The transmitter support is adjustable forward and back by slots and clamp nuts at the receivers. Moreover, it is adjustable up and down by swinging the arm on its pivots. When not needed it may be thrown over the head of the operator.

SET FOR INTERCOMMUNICATING SYSTEMS.

With intercommunicating systems it is almost always necessary to run a considerable number of wires from each station to every other. It is necessary to provide slightly more than as many pairs of wires as there are stations in the system between each two stations. With most systems these wires are run in cable form, the cables being terminated upon special cable blocks providing for the required number of pairs, one to be mounted near each station. Mr. H. C. Thompson, of Boston, has felt that an improvement could be made provided terminal and subscriber sets be combined in one unit, and, to this end, he has combined the terminal block and the base of the telephone set and has arranged suitable means for the entrance and egress of the cable. Mr. Thompson has assigned the patent for this type set to the Electric Goods Manufacturing Company.

Letters to the Editors.

The Industries and the Public Library.

To the Editors of Electrical World:

Sirs:—Mr. H. S. Knowlton, in his letter in your issue of Aug. 15 on "The Electrical Engineer and the Public Library," has raised a very broad and a pertinent question in asking whether it "would not be productive of lasting good if a little less money (was) spent for cheap popular novels and a little more devoted to the maintenance of the periodical list useful to the engineering world."

Hence, it may interest your readers to learn that the technical departments in the mills and factories of many of the industrial enterprises within 100 miles of Pittsburg have the habit of appealing by letter or telephone, as well as by personal visits of representatives, to the technology department of the Carnegie Library of Pittsburg for statistics, data or other information that will assist in determining important technical questions or in solving industrial problems.

This dependence on this library has come about through a full appreciation on the part of the librarian of the immeasurable value to workers of every industry of an easy and free accessibility to the important technical and trade literature of the world's work. For this department not only gathers the best that has been published concerning the inception, growth and development of industrial occupations, but it endeavors to classify and keep in accessible form indexes to all current technical literature relating thereto. It also collects and classifies important trade catalogs and descriptive pamphlets that ordinarily may possess only an ephemeral trade value, yet sometimes are serviceable in determining historical, technical or legal points.

Furthermore, this department has a complete set of United States patents arranged chronologically, and has the cases prepared and is about to secure a classified set, affording immediate access to all patents in any line of invention. So far as local inventors are concerned, this classification is now available only in Washington. Hence, inventors must expend time and money if they go there to ascertain what earlier workers have devised in definite lines of invention, and as such information is often absolutely necessary, this expense is an unjust burden on the practical workmen of limited means who originate most of the inventions for which letters patent are granted and whose services rightfully entitle them to opportunities for consulting this classification of patents here at home.

This department also has the only known complete set of English patents on file between the cities of Philadelphia and Cincinnati. It has a complete set of abstracts of the German patents, and has sets more or less complete of the patent publications of some other nations, including a complete set of French patents up to the year 1900.

There is no question of the practical usefulness of this department of the Carnegie Library to the industrial interests in western Pennsylvania, or of the timely, ever-widening and admittedly valuable services it has so cheerfully rendered during the past seven years, because successful business men eminent in their respective industries, and bankers representing hundreds of millions of dollars, and engineers and technical men have found pleasure in placing on record their high commendation of the character and scope and value of the services rendered by this department.

Yet, strange as it may appear to people who often hear our politicians prate about Pittsburg being "the center of America's industrial empire," and of "the world's greatest wealth-producing region," the technology department still constitutes a part of the main reference room, although a separate room was shelved and furnished throughout in expectation of being occupied by this department. The arrangement of this room was designed to afford the maximum of accessibility with a minimum loss of time, yet it has never been occupied for lack of money to maintain it. And this condition of affairs is likely to continue until those who are being benefited by the work of this department take the time to show their respective Councilmen the many material advantages that might accrue to their constituents through the opening of opportunities for advancement, if certain trade or technical information was easily accessible to men who believe they can devise improvements in means or methods or machinery or effect important savings in processes employed.

Pittsburg, Pa. Fred De Land.

Impregnated Poles.

To the Editors of Electrical World:

Sirs:—The article in your issue of Aug. 22, page 384, entitled "Destruction of Wooden Electrical Poles," recalls a sojourn by the writer in California, where the woodpecker has developed proclivities which make him a nuisance to the owners of wooden poles. As to the recommendation to employ creosoted poles, in talking with a lumberman recently, he stated that the use of those impregnated with creosote increases the risk of their taking fire either accidentally or designedly; in proof of this he said that one may see railroad ties smoking, in fact, glowing, owing to the accidental dropping of a live coal from the ashpan of a locomotive. If this is correct, the employment of creosoted poles is neither desirable nor economical. As a substitute the writer would suggest the use of soda silicate, the impregnation being done by means of the regular vacuum system used with creosote. The use of this salt acts not only as a preventive against fire, but increases the life of the pole and would thwart the insidious offspring of the *Campephilus principalis* (or perhaps that of the *Melanerpes erythrocephalus*) from making telegraph and telephone poles their abiding place, or, what is more likely, a storehouse against a lean season.

Brooklyn, N. Y. H. Frederic Frasse.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Railway Motors.—J. Sahulka.—A description of an alternating-current motor consisting of two movable parts and said to be especially suitable for traction and haulage. The construction is shown in Fig. 1. L_1 and L_2 are the two conductors of the line, one of these may be the rails. M is the main motor, the two parts of which, B and C, are both movable. The part B acts on the axle a_1. The part C drives a direct-current shunt generator D which supplies energy to a direct-current series motor F, which is called the auxiliary motor. The auxiliary motor F acts on the axles a_2, and the two axles a_1 and a_2 are coupled together. The generator D and the auxiliary motor F need to be designed for only one-half the rating of the main motor M. The operation is as follows: In starting the circuit connecting the generator D and auxiliary motor F is open so that the main motor M is started unloaded. Only the part C will rotate and will drive the generator D. The exciting circuit of the dynamo has a high resistance, so that in spite of the high speed, the e.m.f. is low. In order to start the driving axles the circuit between the generator and the auxiliary motor is closed, and the excitation of the generator is gradually increased. The current which is supplied to the auxiliary motor F is thereby increased. The dynamo acts like a brake on the outer part C of the main motor. The inner part B now tends to rotate in a direction opposite to that of the outer part and thereby acts on the driving axle a_1. As soon as the torque becomes sufficiently large

the axles will begin to rotate. By increasing the exciting current of the generator, its braking effect is increased so that the speed of the outer part of the main motor and the speed of the generator decrease, while the speeds of the inner part of the main motor and of the driving axles increase. The speed of the axles is regulated by means of a regulating rheostat in the exciting circuit of the generator. If the main motor is an induction machine, it will run with only small slip and the relative speed of one part of the main motor with respect to the other will be approximately constant. If the main motor were a synchronous machine, the relative speed of these two parts with respect to each other would be always strictly constant. The shunt winding of the dynamo is so designed that with short-circuited regulating rheostat the two parts of the main motor rotate with equal speed in opposite directions (that is, with half the speed of the outer part when the main motor is unloaded). In this case the main motor transfers one-half of its mechanical work directly to the axles, while the other half of the energy is supplied to the generator. Through the intermediary of the generator and the auxiliary motor the second half of the energy is also transferred as mechanical work to the axles. It will be seen that the main motor must be started only once. When the driving axles are at rest, the main motor

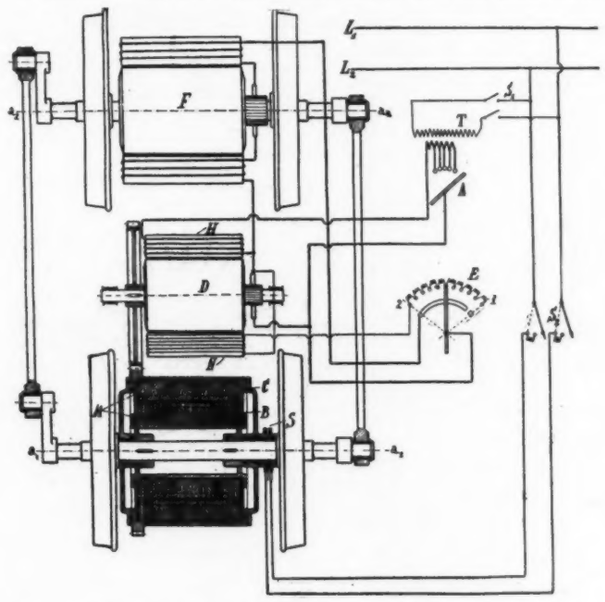


FIG. 1.—ARRANGEMENT OF APPARATUS ON ELECTRIC LOCOMOTIVE.

runs unloaded at full speed. If the direction of rotation of the driving axles is to be reversed, the main motor must first be stopped. The generator *D* has laminated field poles and has series and shunt excitation windings so that this machine may be used as a direct-current shunt generator or as a single-phase series motor. For starting the machine *D* as a single-phase series motor the secondary e.m.f. of transformer *T* is adjustable. The starting current is said to be low. When running down hill energy is returned to the network. Finally, an application of the motor to a three-phase system is described.—*Elek. u. Masch.*, July 26.

Speed Regulation of Induction Motors.—C. KRAEMER.—A German company is using for speed regulation of induction motors a system of the author which is in principle identical with that proposed by Heyland for starting and stopping motors for single-phase railways. The secondary currents due to the slip are taken from the rotor and supplied to a synchronous converter, which supplies energy to a direct-current motor. The latter is on the same axle as the induction motor, and its excitation is adjustable. The method is especially suitable for rolling-mill motors and for the Ilgner system of winding, but is less suitable for ventilators. For the latter case a modification of the method has been devised.—*Elek. Zeit.*, July 30.

Alternating-Current Commutator Motors.—R. GOLDSCHMIDT.—A continuation of his long illustrated serial on the theory of the single-phase commutator motor. In the present installment the author discusses the circulating currents in the short-circuited coil.—Lond. *Elec.*, Aug. 21.

Theory of Commutation.—J. BETHENOD.—A brief note supplementing his recent mathematical paper. The author shows how the necessary and sufficient conditions under which the current density does not become infinitely great at the breaking of an inductive circuit, may be extended to cases in which the resistance and the reactance of the circuit are variable.—*La Lumière Elec.*, Aug. 22.

Heating of Motors.—W. HARTNELL.—An illustrated paper read before the Leeds Section of the Brit. Inst. Elec. Eng. The author deals with motors of eight types, classified according to their system of ventilation. He arrives at the conclusion that totally enclosed motors are under a great disadvantage. and that, in general, their use can be avoided. He gives particulars of tests in support of this view. Figures regarding cooling surface are also tabulated, and the results are plotted as curves.—Lond. *Elec.*, Aug. 21.

Series Repulsion Motor.—R. RICHTER.—The author first describes the series repulsion motor of Alexanderson and then begins to criticise it, dealing first with the suppression of sparks. The article is to be continued.—*Elek. Zeit.*, Aug. 20.

Unipolar Dynamos.—C. FELDMANN.—The author gives some notes on the mechanical design of acyclic dynamos built by the General Electric Company.—Lond. *Elec.*, Aug. 21.

Coil-Winding Machine.—An illustrated description of an armature-coil winding-machine which is in extensive use and which obviates the necessity for separate formers for each size of coil. The machine is perfectly adjustable in each dimension, and can, therefore, be used for winding any size of coil to the greatest nicety within certain ranges. Moreover, when the coil is wound it can be "formed" with one movement of the machine so as to have the kinks at right angles to the coil in the most approved size.—Lond. *Elec. Eng'ing*, Aug. 20.

Lamps and Lighting.

Metallic-Filament Lamps.—B. DUSCHNITZ.—A summary of various recent methods for the manufacture of metallic-filament lamps, based mostly on patent specifications. The author first deals with various methods of making filaments from oxides of rare earths. J. M. Canello makes a filament consisting of a core of thorium oxide, covered with a layer of osmium or ruthenium, this layer being again covered by a layer of thorium oxide. The reasons which finally lead to the destruction of such filaments are discussed. They are primarily due to the different expansion of the thorium oxide and osmium. The latter has the higher coefficient of expansion and, therefore, presses strongly against the surrounding thorium oxide layer. The Wolframlampen Company, of Augsburg, uses the oxides of tungsten or molybdenum as a starting material for producing tungsten etc., filaments; the special feature is the exclusion of organic binding materials. J. Lux prepares a paste of tungsten oxide and carbon to which he adds a small quantity (0.1 to 0.5 per cent) of aluminum or magnesium. The reduction of the oxide is thereby greatly facilitated. The oxides of aluminum or magnesium which form are later removed by evaporation. Siemens & Halske make use of the high ductility of thorium (even if containing up to 10 per cent of oxide) for the production of filaments by a purely mechanical process. Additions of tantalum or tungsten are also employed. The author then discusses the production of metallic filaments from carbon filaments or with the use of organic binding materials. The German Welsbach Company has found that osmium filaments containing chromium or molybdenum or tungsten or uranium are just as resistive in a vacuum as pure osmium filaments. The same has been found for osmium-iridium filaments, but they are expensive and brittle and consume not less than 1.7 watt per hefner candle. To make tungsten and other metallic filaments, tungsten metal is finally powdered and mixed with sugar or some other organic substance to form a paste to which lampblack is added. The filaments are then formed and

dried and are reduced in an atmosphere of hydrogen and steam. The quantity of hydrogen must be 10 to 20 times that of steam. The hydrogen acts as a reducing agent, while the small quantities of steam remove the carbon in the form of carbon dioxide. If too much steam is used there is a danger of oxidizing the metal. For this reason the Welsbach Company has now modified the above process by substituting nitrogen for steam. The reduction is carried out in an atmosphere of hydrogen and nitrogen. The carbon is removed in this case as dicyanogen $C_2 N_2$. Among methods employed by the Wolframlampen Company, of Augsburg, the following is of special interest: A very thin filament of carbon (diameter 0.02 mm to 0.06 mm) is covered with a layer of tungsten in an atmosphere of an oxychloride of tungsten. This tungsten-covered filament is then placed in an atmosphere of very dilute inert gas, for instance, hydrogen, the pressure being 20 mm of mercury. The filament is then electrically heated to white heat. The result is that part of the carbon evaporates, while the balance of the carbon forms a carbide with the surrounding tungsten. It is claimed that in this way an absolutely homogeneous filament is produced. This is then decarbonized, for instance, by placing the carbide filament in a crucible filled with finely powdered low oxide of tungsten and heated to a temperature of 1600 deg. C. The tungsten oxide combines with the carbon, giving off carbon monoxide. The Parker-Clark helion lamp is then described, and some of the recent methods of the Siemens & Halske Company for making tungsten filaments. Carbonized vegetable fiber is impregnated with a paste of a colloidal solution of a tungsten compound and conducting low oxides of tungsten are added. By heating with the electric current, the filament is decarbonized and simultaneously the metal is reduced.—*Elek Anz.*, July 3, 16, 30, Aug. 9 and 20.

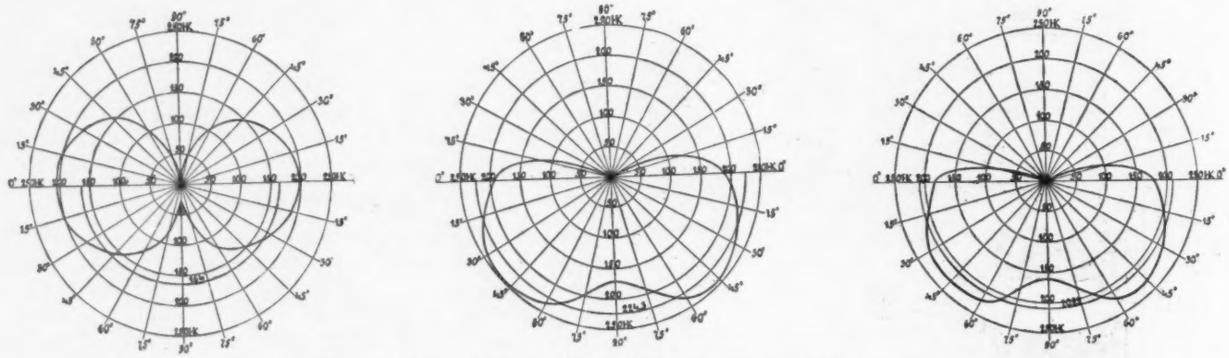
Osram Lamps vs. Small Arc Lamps.—H. Remane.—High-candle-power osram lamps have entered into competition with small arc lamps. Such osram lamps are made in ratings of 200, 300 and 400 hefner candles for e.m.fs. of from 110 to 130 volts and from 200 to 250 volts with a specific consumption of from 1.0 to 1.1 watt per mean horizontal hefner candle. Tests both with direct current and alternating current have shown a useful life of 800 hours, during which the candle-power decreases by from 5 to 6 per cent. The polar candle-power curves are shown in Figs. 2, 3 and 4. Fig. 2 refers to a 200-cp osram lamp without reflector. Fig. 3 refers to a 200-cp osram lamp with reflector, but without a second protective glass globe; this type is used for internal lighting. Fig. 4 refers to a 200-cp osram lamp with reflector and with a second protective globe of clear glass; this type is used for street lighting. The mean spherical candle-power is 79 per cent of the mean horizontal candle-power. The same figure has been found in the Reichsanstalt for osram lamps up to 50 cp. This gives a specific consumption of 1.39 watt per mean spherical hefner candle-power. The specific consumption per mean lower hemispherical hefner candle-power is 1.33 watts. The outer protective globe, used in the type of lamp for street lighting, absorbs about 7 per cent of the candle-power. The author compares osram lamps and arc lamps with respect to the relation between efficiency (for the lower hemisphere under conditions of practice) and the size of the lamp. He finds that the efficiency of osram lamps is greater than that of direct-current open arc lamps of less than 5 amp and greater than that of alternating-current arc lamps with pure carbons of less than 15 amp. Direct-current enclosed arcs are found to be always less efficient than osram lamps; even lamps of 6.5 amp and 500 hefner candles are less efficient by about 30 per cent than osram lamps. In the same way the author compares the cost of operation of arc lamps and osram lamps, and finds that osram lamps are commercially superior to direct-current open arc lamps of less than 6 amp and to alternating-current open arcs of any size up to 20 amp, and to enclosed arcs of any size up to 6.5 amp.—*Elek. Zeit.*, Aug. 20.

Determining the Mean Spherical Candle-Power.—E. W. Weinbeer.—Kennelly's graphical method for finding the spherical or hemispherical candle-power (Electrical World, March 28, 1908) has been employed by the author for the design of a simple slide rule which gives the mean spherical candle-power even more quickly than the graphical determination.—*Elek. Anz.*, Aug. 6.

Reflectors.—E. W. Weinbeer.—An article illustrated by diagrams, describing a simple graphical method for designing a reflector to fulfil certain conditions—*Elek. Anz.*, Aug. 2.

Generation, Transmission and Distribution.

Electric Motors in Mines.—W. Bolz.—The first part of a profusely illustrated article on electric motors in the mines of the Ilse Company, in Germany. Since there are a number of mines at some distance from each other, three-phase currents at 2000 volts are employed, the frequency being 50. Generating stations are provided at the different mines and for transmission to one mine an e.m.f. of 15,000 volts is used. Since the company makes brown-coal briquets, a considerable quantity of steam at a pressure of two to three atmospheres is required for drying the coal. If in the power station steam of high pressure is produced, say, at 13 atmospheres, the steam engines may expand the steam from 13 to 3 atmospheres and the balance of the heat of the steam can be utilized to the fullest extent for the drying of the coal. The price of the generated electrical energy is very low under such circumstances.—*Elek. Kraftb. u. Bahnen*, July 24.



FIGS. 2, 3 AND 4.—POLAR CANDLE-POWER CURVES OF OSRAM LAMPS.

Electricity in Mines.—K. Perlewitz.—The first part of a long illustrated description of the electric equipment of a number of coal mines near Recklinghausen, in Germany. Three-phase currents at 5000 volts are used. There are two power plants, the newer one containing two steam turbines, the older one a reciprocating steam engine and a gas engine. In the present installment the steam-turbine plant is described; the rating of each of the two generating sets is 1800 kw.—*Elek. Zeit.*, Aug. 20.

Generating Station in a Coal District.—L. Pasching.—An illustrated description of a power plant erected in a coal district in upper Italy. The coal mined is lignite, and contains from 40 to 50 per cent of water. Shipping would, therefore, be expensive. It has, therefore, been decided to erect a steam-power plant at the mine and transmit three-phase currents at 33,000

volts over five lines to Florence and other cities in the neighborhood—*La Lumière Elec.*, Aug. 8 and 15.

Tests of Turbo-Alternators.—Tests of a 6000-kw turbo-alternator at Manchester showed steam consumption below 16 lb. per kw-hour, with steam at 190 lb. with 100 deg. Fahr. of super-temperature, and a vacuum of 27 in.—Lond. *Elec. Eng'ing*, Aug. 20.

Water Powers.—H. VON SCHON.—An article on the use and conservation of water-power resources. A definite plan is given for federal, state and corporation co-operation.—*Eng'ing Mag.*, September.

Traction.

Electric Operation of Main Railroads.—W. REICHEL.—An account, based on official reports, of a very careful and extended investigation of the proposed introduction of electric operation on the State Railways in Bavaria. The first part deals with the calculations of the electric power required for railway networks. The maximum of the load curve is found to be three times the average load. Either an hydraulic or an electric system of storing energy is, therefore, necessary. Even if the traffic should increase by 42 per cent to the year 1920, all the power required for the railways of Bavaria could be supplied by available water powers. In a very thorough discussion of the different systems, the single-phase system is proved to be the most preferable. Finally, the subject is discussed from a financial point of view, and it is shown that the introduction of electric operation would be specially profitable on the railways in the southern part of Bavaria. The report contains many tables and figures.—*Elek. Kraftb. u. Bahnen*, May 4, 14, June 4, 13, and July 4.

Traction Motors with Interpoles.—H. SEHENKEL.—Under ordinary conditions of tramway operation at 1500 volts with 30-hp motors, there is no advantage in employing interpoles. In the case of the interurban railway from Mayenze to Wiesbaden, however, it was desired to use a speed of 30 miles per hour outside of the cities and low speed within the cities themselves, and comparative experiments showed that the necessary speed regulation could be obtained only with motors equipped with interpoles. The motors have four main poles and four interpoles.—*Elek. Kraftb. u. Bahnen*, July 24.

Substation.—An illustrated description of a typical substation of the Chicago City Railway. It is one of five substations and contains at present four 2000-kw rotary converters. The construction of the station is notable for the entire absence of wood.—*Elec. Railway Jour.*, Aug. 15.

Installations, Systems and Appliances.

Munich.—Electricity supply on a large scale was not begun in the city of Munich until 1899, when a steam plant with five 800-kw, 5000-volt, three-phase generators was installed, the three-phase current being converted to direct current in substations for lighting and traction purposes. To meet the increasing demand, two water-power plants have now been erected, of which one at Maria Einsiedel was opened in 1907, containing three 1300-hp, three-phase generators. The second plant, which is called the Uppenborn power house, near Moosburg, was opened in the spring of 1908, and is located at the lower Isar River and about 32 miles from Munich. It contains three 5000-volt, 1400-kv-amp, three-phase generators. The voltage is raised in two 1800-kv-amp transformers to 50,000 for transmission to Munich.—Report to Siemens-Schuckert Werke in *Elek. Zeit.*, Aug. 20. A detailed illustrated description of the Uppenborn power plant is given by S. Meyer, H. Niesz and K. Dantscher in *Elek. Kraftb. u. Bahnen*, June 4, 13, 24 and July 4.

Electrophysics and Magnetism.

Magnetic Properties of Special Steels.—P. WILSON, V. H. WINSON AND G. F. O'DELL.—An account of tests of the magnetic properties of two special steels of Hadfield, called stalloy and lohys, which have been repeatedly noticed in ELECTRICAL WORLD. The present tests were made with very small magnetic forces. The magnetic properties were investigated by the ballistic-galvanometer method. Figs. 5 and 6 show the various quantities plotted in terms of the maximum value of the magnetic induction B. Curves of permeability are also given in Fig. 6 for a very pure iron specimen, and a piece of transformer plate rolled from Swedish iron. They show that the permeability of stalloy is high for comparatively small values of the magnetic induction B, but rapidly diminish as B is increased. The hysteresis loss for each of these specimens lies about midway between those for stalloy and lohys. It is interesting to note that the curves of permeability for values of the magnetic induction B varying from 15,000 to 22,000 continue the curves of permeability given in Fig. 6, the change of the slope of the curve between the two being, however, somewhat abrupt in each case. A matter which has received further attention is the value of $\int HdB/H_0B_{max.}$, where H_0 is the coercive force corresponding to the particular maximum value of the magnetic induction B. Sumpner has pointed out that this quantity is accurately

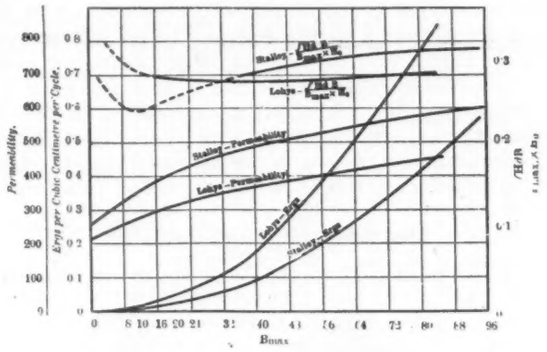


FIG. 5.—TESTS OF STEEL ALLOYS.

represented by a linear function of the maximum induction B over a large range. It will be seen from Figs. 5 and 6 that this law ceases to hold for very small values of B. The Steinmetz coefficients have been found between the values of the induction B, varying between $B = 1$ and $B = 13{,}500$, the law being ergs per cubic centimeter per cycle $= \alpha B^{\beta}$. α varies between 0.000000752 and 0.000363 for stalloy and between 0.0000179 and 0.00148 for lohys. β varies between 1.72 and 2.69 for stalloy and between 1.59 and 2.46 for lohys. The mean specific resistance at 15 deg. C. for stalloy is 49.63×10^{-6}, and for lohys 14.25×10^{-6}; while the mean temperature-resistance coefficients between 0 deg. C. and 50 deg. C. were 0.003975 and 0.00424, and between 0 deg. C. and 100 deg. C., 0.00103 and 0.00446, respectively. It is interesting to note that the eddy-current loss

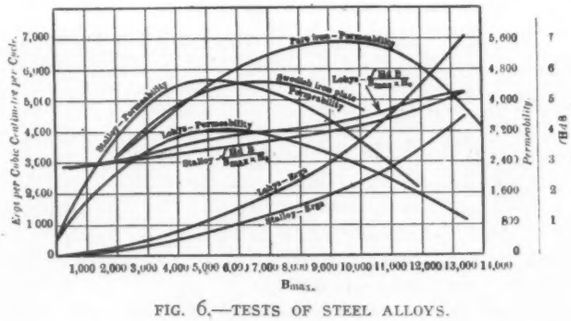


FIG. 6.—TESTS OF STEEL ALLOYS.

calculated by aid of the ordinary formula when added to the hysteresis loss gives a curve of total energy loss in close agreement with that published by the manufacturers. As would naturally be expected, the high specific resistance of stalloy results in a very low eddy-current loss.—Lond. *Elec.*, Aug. 21.

Pig Iron.—H. KREUSLER.—An account of an investigation in which the author took great care to produce pure iron. He precipitated iron oxalate from iron-ammonium sulphate. The oxalate was ignited, and the resulting oxide reduced by pure hydrogen. The spongy iron was dissolved in hydrochloric acid, again precipitated with oxalic acid and the process repeated. Great difficulty was experienced in getting rid of sulphur. He

finally succeeded by forming an arc between electrodes of purified iron and letting drops of iron fall into mercury. The iron thus treated looks exactly like platinum. It is exceedingly ductile and malleable, is not attacked by hydrochloric acid, but rapidly dissolves in nitric acid. Compared with the best dynamo sheet iron it shows a much greater hysteresis. This proves that hysteresis is not due mainly to impurities in the iron as has been sometimes supposed. As regards conductivity, it is markedly superior to any yet found in iron. Lorenz's highest value is 9.685 at 0 deg. The author's is 10.61. The author enclosed wires of the pure iron in incandescent lamps and heated them to a yellow glow. They did not give off perceptible amounts of gas. Contrary to the behavior of ordinary iron, the resistance was not affected by the treatment.—*Verhandlungen* of German Phys. Society, No. 9; abstracted in Lond. *Elec. Eng'ing,* Aug. 20.

Heating of Conductors.—L. Roy.—The conclusion of his article on theoretical and experimental researches on the heating of conductors by electric current. In the present installment the heating of a rectangle of infinite length, the ends of which are held at constant potential, is discussed under given conditions of cooling. The author also studies the period of cooling after the breaking of the circuit. The theory is chiefly of mathematical interest, but the author states that his formulas may be used for the design of fuse wires.—*La Lumière Elec.,* Aug. 8.

Electrochemistry and Batteries.

Gold Refining in Mint.—R. L. Whitehead.—The first part of a long and profusely illustrated description of the processes of electrolytic refining of gold, silver and copper at the United States Mint in San Francisco. For gold refining the Wohlwill process is used, a special method of circulation being employed. For silver refining the Thum process is used. The equipment of the tank rooms, of the generator room and of the laboratory are described.—*Electrochem. and Met. Ind.,* September.

Nickel.—E. F. Kern and F. G. Fabian.—An account of an extended experimental investigation on the use of various electrolytes to obtain good electrodeposits of nickel. Electrolysis of neutral chloride and fluosilicate solutions with current densities of from 10 to 20 amp per square foot gave satisfactory deposits and high current efficiencies. The most satisfactory temperature was 50 deg. C.—*Electrochem. and Met. Ind.,* September.

Electric Furnaces for Iron and Steel.—A. Solier.—A brief review of the different types of electric furnaces for use in the iron and steel industry. The article seems not to contain anything new.—*La Lumière Elec.,* Aug. 15.

Storage Batteries.—P. R. Moses.—The author discusses the functions of a storage battery in an isolated plant, and describes the construction and operation of the leading types of batteries on the market.—*Eng'ing Mag.,* September.

Units, Measurements and Instruments.

Selenium Cell.—G. M. Minchin.—Details of his experiments on a new type of sensitive selenium cell. The cell—which the author calls a "seleno-aluminium bridge"—is made by placing a plain piece of aluminum at each side of a very thin sheet of mica and then cutting perpendicularly through the three layers. The cut edge is taken and trued up, and on it is smeared a very thin layer of molten selenium. The aluminum pieces are thus electrically bridged by the selenium. The selenium is heated till it assumes the brownish-gray conducting form. When the length of the bridge is about a centimeter, and the thickness of the mica about one-hundredth of a millimeter, the resistance of the bridge under an e.m.f. of 2 volts may be from 40 to 50 megohms. The author states that it is advantageous to coat the selenium with a thin layer of solid paraffin. After numerous experiments the author has been led to an empirical formula connecting the intensity of light falling on the selenium with the current through it.—*Proc. Royal Society,* July; abstracted in Lond. *Elec. Eng'ing,* Aug. 13.

Thermo-Electric Pyrometers.—C. Offerhaus and E. H. Fischer.—An illustrated article giving the results of an experimental investigation on the cold-junction temperature corrections of the platinum, platinum-rhodium and of the platinum, platinum-iridium thermoelectric pyrometers.—*Elec. and Met. Ind.,* September.

Cooling Curves.—G. K. Burgess.—The first part of a long investigation of different methods of obtaining cooling curves with the use of the thermocouple. After briefly describing the use of the thermocouple and different methods of recording, the author discusses temperature time curves and various differential curves. The paper is to be concluded.—*Electrochem. and Met. Ind.,* September.

Mercury Ammeter for Large Currents.—An illustrated description of a "mercury ammeter" for large currents designed by E. F. Northrup. It is based on a pinch effect, the rise of a mercury column indicating the value of the current directly. It is suitable for measuring any current above 500 amp.—*Electrochem. and Met. Ind.,* September.

Induction Meter.—An official communication of the Reichsanstalt by which a three-phase induction watt-hour meter of the Siemens-Schuckert Company is admitted for calibration. The meter is a combination of two induction motors, the construction being described in detail by means of diagrams.—*Elek. Zeit.,* Aug. 20.

Roentgen Ray Tubes.—E. Ruhmer.—An illustrated article on the operation of Roentgen-ray tubes with purely unidirectional induced currents. He describes a new unidirectional arrangement for which he claims great simplicity and efficient operation.—Lond. *Elec.,* Aug. 7.

Telegraphy, Telephony and Signals.

Thermoelectric Detectors.—E. Branly.—In connection with Tissot's recent description of thermoelectric detectors, the present author states that as long ago as 1891 he used combinations containing tellurium as detectors in wireless telegraphy. Such combinations included tellurium-steel, tellurium-silver, tellurium-gold and a combination of tellurium with mercury and steel. The more usual arrangement was a tripod of tellurium or some telluride on a polished steel plate or disk. The circuit consisted of a telephone, a cell giving 0.1 volt, and the tripod and disk. That the effect was not thermoelectric was proved by the fact that the tripod may also be provided with steel feet without losing its efficacy, but tellurium is both more sensitive and more regular in its action. Comparing such detectors with the electrolytic type, the author remarks that though the latter are the more sensitive, he prefers the tellurium detector for use in the laboratory.—*Comptes Rendus,* July 13; abstracted in Lond. *Elec. Eng'ing,* Aug. 6.

Wireless Telemechanics.—E. Branly.—The author has worked out improved methods for the electric control of mechanism at a distance without wires. The chief trouble is how to guard against accidental spark waves and especially against wave trains of considerable duration from wireless telegraph stations. To obviate this trouble the author uses the following method: The control apparatus is arranged for five recurrent periods, to each of which is assigned a separate function. Unless each function is carried out in the succession appointed, the mechanism stops. The periods are governed by the motion of a rod having three soft-iron sections, which are sucked into three different solenoids. The first period is used for starting, but if the start is false (of which a bell warns the operator automatically), the second period may be used for stopping. Otherwise, it is left unused.—*Comptes Rendus,* July 20; abstracted in Lond. *Elec. Eng'ing,* August 6.

Telephone Repair Factory.—An illustrated description of the repair factory of the National Telephone Company, where instruments removed from the subscribers are overhauled. Part of them must be "condemned," but even these are carefully broken up, and all useful parts are systematically recovered, while the scrap is sorted out so that it may be disposed of to best advantage. The greater part, however, including practically all the instruments of standard type, are renovated. The arrangement of the different departments in which this is done is described.—Lond. *Elec. Eng'ing,* July 30.

Alternating-Current Potential-Regulators.—G. R. Metcalfe.—An article describing different types of potential regulators

for alternating-current systems. The author first describes the induction type for single-phase and polyphase circuits and discusses the control of the operating motors by means of relays. The voltage regulating relay and the auxiliary relay are described. The author then deals with the step-by-step type, drum-type regulators and dial-type regulators being described. —*Elec. Jour.*, August.

Arc-Lamp Copying Apparatus.—An illustrated description of a "photocopier" in which tracings can be copied continuously for the production of blue prints, with the aid of the arc lamp. "With rapid ferroprussiate paper cut to the size of each tracing and fed into the machine, 50 prints an hour can be made."—Lond. *Elec.*, July 31.

Wireless Telephony.—L. H. WALTER.—An illustrated article in which the author considers the relative merits of a number of systems of wireless telephony, which have been suggested and used, both as regards the methods of arranging the microphone in the sending apparatus to control the oscillations, and the most suitable forms of detector for this class of work.—Lond. *Elec. Eng'ing*, Aug. 13.

Telephone Cables.—An illustrated description of several special telephone cables recently laid by the British Postoffice.—*Amer. Tel. Jour.*, July 25.

BOOK REVIEW.

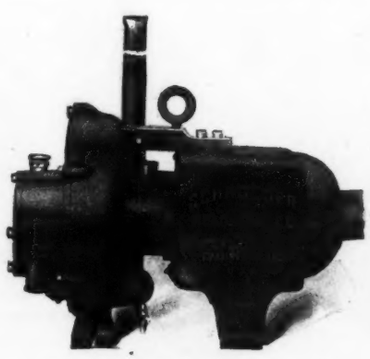
MESURES ELECTRIQUES. Par Erie Gerard. Paris: Gauthier-Villars. 708 pages, 304 il ustrations. Price, 12 francs.

In this third edition the distinguished professor of electrotechnics at the University of Liége has not failed to introduce recent important advances made in the methods and in instruments for the measurement of electrical quantities. A lengthy chapter is devoted to the equipment necessary for laboratories intended strictly for scientific purposes and also for others intended for the industrial applications of electrictiy. Coefficients of induction, magnetic permeability and hysteresis are treated at length, as also the alternator, alternating current and transformers, together with the various phenomena to which they give rise. The demand which there is for these volumes of M. Gerard is a reliable indication of their excellence.

NEW APPARATUS AND APPLIANCES

Compact Turbo-Generator Unit.

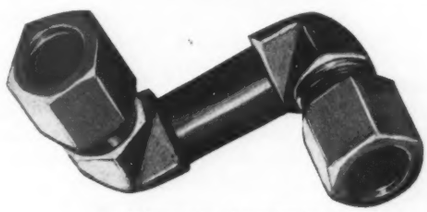
The accompanying illustration shows a steam turbo-generator which was designed primarily for use with locomotive headlamps. It has proved so reliable and satisfactory in this service that it is now being placed on the market for use where cheap small electric generating units may be wanted. It is said that neither the turbine nor the generator requires any attention, the addition of a small amount of grease to the bearings once a week being the only requirement for continuous operation. All of the revolving parts are mounted on ball-bearings which run without noise. An outfit designed for 1 kw occupies a floor area of 22 in. x 13 in., and weighs only 160 lb. The windings are heavily insulated and baked with special compounds so that no damage can be caused to the insulation by moisture from the steam. These turbo-generator units, which were designed by Mr. J. P. Nikonow, are manufactured by the Schroeder Headlight Company, Evansville, Ind.



COMPACT TURBO-GENERATOR UNIT.

Double-Bend Solderless Connector.

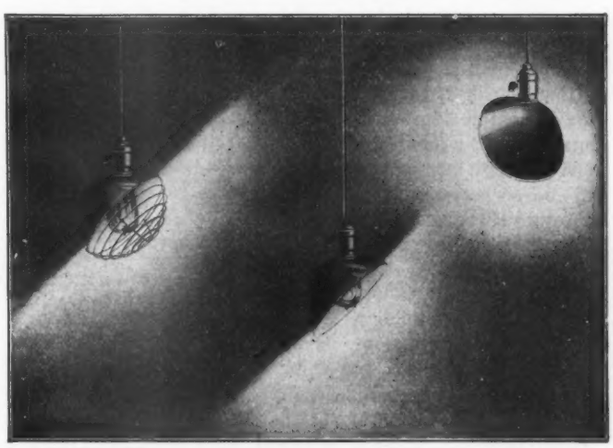
The accompanying illustration shows a special type of solderless connector used at the Dutch Point generating station, Hartford, Conn., installed by Westinghouse, Church, Kerr & Company. Connectors rated at 300 amp and 600 amp are employed for joining copper rods to 2400-volt oil circuit-breakers. The circuit-breakers were built up in masonry work, and the problem of connecting the outgoing buses to the breakers was a rather difficult one, owing to the limited space for making short bends. An easy solution of the problem was found in the use of the elbow connector illustrated. This connector was made by Dorsett & Company, 242 West Forty-first Street, New York.



SOLDERLESS CONNECTOR.

Metal Reflectors.

The acompanying illustration shows Holophane-D'Olier reflectors, which are being placed on the market by the Holophane Company, 227 Fulton Street, New York. The reflectors are of the metal type designed by Mr. Henry D'Olier, Jr., the interior finish being a special "satin aluminum" produced by secret process and giving a soft, well-diffused reflection. Each reflector is provided with an attached clip spring holder, reinforced with a heavy steel ring. The reflectors are particularly

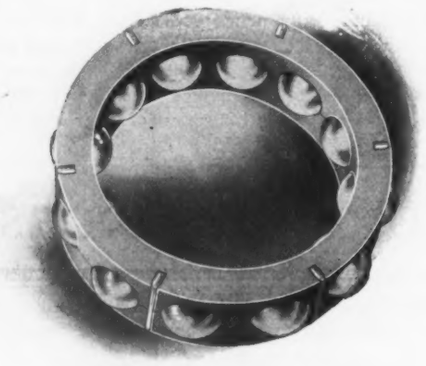


METAL REFLECTORS.

well suited for use in industrial plant lighting; in certain classes of display-window lighting, and in many cases where excess of grime or liability to breakage is present and where the use of glassware is almost always inadvisable and frequently absurd.

"Silent" Annular Ball Bearing.

A new type of "silent" annular ball bearing which is claimed to possess some special advantages over preceding types is shown in the accompanying illustration. This new bearing is made by Fichtel & Sachs, of Schweinfurt, Germany, and resembles former ball bearings made by that firm in respect to the method of introducing the balls. This method is to form



ANNULAR BALL BEARING.

angular entering grooves in the sides of the inner and outer races, and after the bearing is half filled to introduce the remaining balls by way of these grooves. Contrary to a possibly common impression, these side grooves are not quite as deep as the races themselves and therefore the balls are sprung in under some pressure. Once in they do not touch the side grooves, and even if they did, the fact that the grooves are angular would prevent them from tending to escape.

In the new type of bearing the distinctive feature is the separator, which is so formed as to permit almost the entire space to be filled with balls. This separator is die-cast on a special alloy and requires almost no machinery. It is split in the central plane of the balls, and the two halves are united by brass wires of dovetail section, which are inserted in dovetail-shaped grooves and have their ends clinched over into notches in the sides of the separator. From the illustration it is seen that the loss as compared with the "full" type is only one ball.

The makers of this bearing lay special stress on the high quality of the materials used and on the extreme accuracy of workmanship and sizing. It is obvious that a bearing such as the one described, having more than the usual number of balls, should distribute its load among several balls instead of concentrating it on three or two, or even on a single ball, as in some types of bearing. To realize this advantage in practice, extreme accuracy in both balls and races as well as perfect uniformity in size of balls is evidently necessary. Fichtel & Sachs claim to have made this degree of accuracy a matter of commercial practice.

These bearings are imported in this country by J. S. Bretz Company, Times Building, New York. They are used in a large variety of situations, among them in automobiles, electrical machinery, power transmission, worm gears, cranes, etc.

Adjustable-Speed Direct-Current Motor Without Interpoles.

One of the obstacles that the designer of direct-current motors has encountered, and which has caused many failures in completed designs, is the tendency of the machines to spark. To obtain a machine which will operate sparklessly under varying speeds and with varying loads, a maintenance of a fixed commutating point is essential. Some of the features which designers have used with a view to obtaining the desired result have been especially designed pole tips and laminated poles. Possibly the nearest approach heretofore obtained in attempting to solve the problem has been the use of what is known as the interpole, or commutating pole. A small pole, located between the main poles and directly over the neutral or commutating point, is wound with heavy wire connected in series with the armature, giving an excitation proportioned to the current in the armature. However, to obtain these conditions it is necessary to sacrifice other factors which are of importance. The auxiliary winding on the small poles operates exactly as an increase in the armature resistance as regards lost watts, thus tending to decrease the efficiency of the machine. It adds to the cost of construction and requires an increase in the diameter of the completed machine.

A motor that is stated to maintain a fixed neutral point gives high efficiency under all loads and operates sparklessly under varying loads and varying speeds is illustrated in Figs. 1 and 2. The field core section is built up of horseshoe-shaped punchings from soft steel plate. The field core has four symmetrical poles, punchings from a single die answering for the entire construction. These punchings are assembled between two cast-iron heads having thin sectional poles extended inwardly to form the enclosing section at the end and to which the rivets or bolts through the pole tips are secured. The large rivets or bolts extend entirely through the end heads and are held with countersunk nuts.

The field structure, after being assembled, is placed under hydraulic pressure, under which condition the bolts or rivets are tightened. This makes the frame work extremely rigid and almost as solid as though it were a steel casting. The special formation of the field structure produces an opening or cored center in each pole, which opening converges toward the center of the pole, meeting at the center on the pole face. This opening extends along the entire length of the armature, virtually separating each pole into two parts, thus making each magnetic circuit entirely independent.

The magnetic circuits are very short and have no joints, the only added reluctance being that of the air gap, and the lines

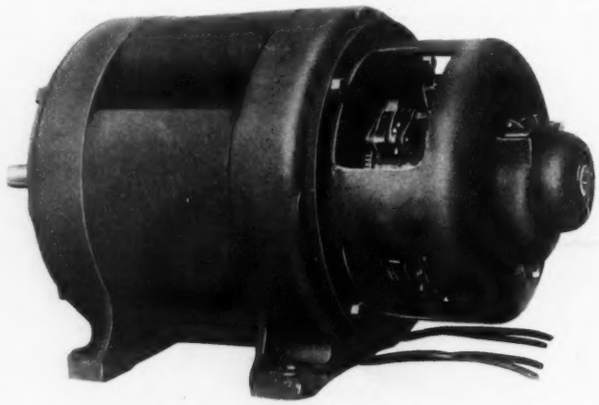


FIG. 1.—COMMUTATOR END OF MOTOR WITH COVER REMOVED.

will have the highest density from pole tip to pole tip. Due to the shape of the hollow in the pole structure and its convergence at the pole face, there is a marked prevention of crowding of the lines of force. Deflection or fanning of the lines can occur only at the point of the air-gap under the trailing pole. In this construction the area of the pole piece at its face is double the area of any other section of the magnetic circuit.

The pole tip that is used in many designs of motors extends outwardly from the main portion of the pole. In the motor here described there is exactly the opposite. The pole extensions are toward the center of the pole piece; the entire construction is such that the densest field is at the pole tips. If there is no distortion or crowding of the lines from the trailing

half of the pole, then the lines of the other half will come directly into the armature with a free and undisturbed circuit, forming a neutral zone of constant position without any of the disadvantages which arise from the use of the interpole. It is claimed that the machine will operate sparklessly under all varying conditions.

It is said that these machines will withstand an overload of 200 per cent or even 300 per cent momentarily with perfect commutation. The speed variation is obtained by weakening the field current; it is stated that a variation as high as 6-to-1 can be obtained without any sparking, and that from 25 per cent to 50 per cent overload can be carried at the highest speeds—that is, with the weakest field.

The coring out or cutting away, forming the hollow poles, is utilized not only to control the magnetic path, but likewise to increase the radiating surface, affording fully 75 per cent more than could be obtained with a frame whose external periphery is circular. The depth of these laminations is much less than that used in an ordinary cylindrical frame having solid pole pieces. This feature permits more ready conduction of heat from the inside of the motor to the open air. Its simplicity of design, together with the increased radiating effect, admits of smaller diameters and shorter magnetic circuits, thus permitting the maintenance of a maximum field strength with a minimum of field copper. The elimination of eddy currents in the magnetic circuit by the laminations allows the field strength to be varied with great rapidity. It is said that the direction of rotation can be reversed from high speed to high speed in either direction more quickly than can be done by any clutch device, the rapid reversing being accomplished absolutely without sparking.

The curves of Figs. 3 and 4, showing efficiency curves, horsepower and speed, were taken from a motor rated at 5 hp when entirely enclosed or 7.5 hp when semi-enclosed motor, giving a 4-to-1 speed variation from 400 to 1600 r.p.m. at 7.5 hp and a 5-to-1 variation from 400 to 2000 r.p.m. at the 5-hp rating. It

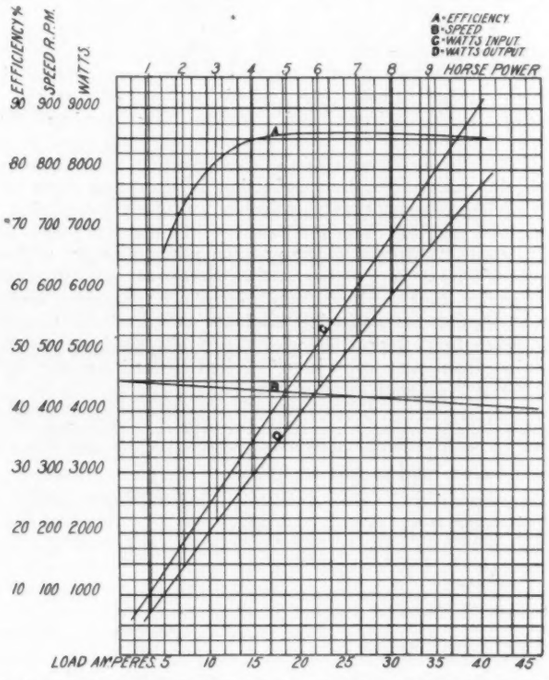


FIG. 3.—CHARACTERISTIC CURVES OF MOTOR RUNNING AT 400 R.P.M.

will be seen from Fig. 3 that at a speed of 400 r.p.m. an efficiency of 86 per cent is obtained, and at a speed of 800 r.p.m. an efficiency of 88 per cent is obtained, with a no-load to full-load speed variation within 5 per cent. The dimensions of this motor are 17¼ in. in diameter and 30 in. over all, the net weight being 600 lb.

These motors are well adapted for driving buffing lathes and grinding machines where the requirements are such that the load varies from 0 to 100 per cent or 200 per cent overload and back with great rapidity. The manufacturer of this motor also makes a full line of buffing and grinding machines for all classes of work and buffing lathes with extended shafts for high polishing and finishing of various grades of silver and brass work. (See Fig. 2.) There is a gain of from 20 to 30 per cent in production with a buffing lathe or grinding machine electrically

FIG. 2.—ENCLOSED MOTOR FOR GRINDER.

self-contained as compared with a belt-driven equipment. Under all conditions with a belt-driven buffing lathe or grinding machine at a high belt speed there is a constant loss or slippage, varying from 10 to 20 per cent and in many cases where there are overloads it far exceeds this value. With the electric grinder, in which the speed is practically constant regardless of the variation in loads, thus always maintaining the same

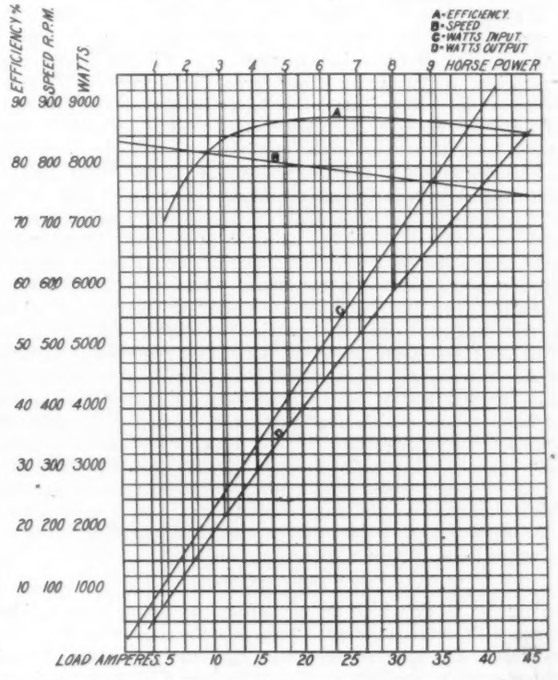


FIG. 4.—CHARACTERISTIC CURVES OF MOTOR RUNNING AT 800 R.P.M.

peripheral cutting speed, there is a steady, even cut, making an increase in production and maintaining a long life to the wheel, which is also conducive to a saving in maintenance.

These motors are being manufactured and placed on the market by the Northern Electrical Manufacturing Company, of Madison, Wis. There is under production a full line of motors ranging in rating from 2 hp to 50 hp in constant speeds, and from 1 hp to 30 hp in the adjustable-speed type with speed ratio up to 6-to-1.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The advent of cooler weather during the first week of September has done much to improve the retail trade and, of course, indirectly the jobbing trade. A seasonable betterment always comes after the urban population returns from its summer vacations and begins business again. The continuance of buyers' excursions brings to the market large numbers of people and, while they are still exhibiting that conservatism which has marked the entire fall trading, they are buying to some extent and the aggregate will result in the movement of a large quantity of goods. The South and Southwest and the Northwest are the most active sections. The movement of crops has increased materially, particularly in the winter wheat sections and in the cotton states, and this has done much to these districts to improve collections. No further trouble on this score is anticipated throughout the agricultural portions of the West. The movement of money to the interior is, however, unusually light not only for the season but for the amount of crop moving that is actually occurring and this can only be translated to mean that the banks throughout the country are plentifully supplied with funds. With regard to the crops, conditions are hardly as rosy as some of the previous reports indicated. Cotton for instance shows greater deterioration, according to the Government report of Aug. 25, than had been anticipated, and while the yield will in all probability be well up toward 12,000,000 bales the bumper yield that was promised is less likely to materialize. Among the cereals there is little change except that in Iowa, Nebraska and some of the great corn centers complaint is made that the weather has been too cool for proper maturing. In industrial lines there appears to be a gradual expansion of output. The latest statistics indicate that in iron and steel the production at the present time is from 70 to 80 per cent of the mill capacity. The United States Steel Corporation, as well as other great producers of finished material, reports satisfactory increases in orders and the large electrical concerns are receiving a comfortable amount of small business as well as numerous inquiries on extensive contracts. The building trade is expanding throughout the West and the lumber industry is more active than at any other time in the past 18 months. This is particularly true in the South and in the Pacific Northwest. Business failures in August, according to reports to *Bradstreet's* were encouraging, being fewer than for any other month since October, 1907. There were 1003 failures, a decrease of 12 per cent from July, but an increase of 49 per cent over August, 1907. Only twice in August since 1892, and then in 1893 and 1896, were more failures reported than there were in August this year. Liabilities for August were $25,575,197, an increase of 14 per cent over July, and were nearly three times those of August last year, having been enlarged greatly by the suspension of the Pillsbury-Washburn flour-milling concern. For eight months of 1908 the failures exceed those of 1907 by 56 per cent, and the liabilities are more than double. Failures for the week ended Sept. 3 were 210, against 236 in the previous week, 130 in the corresponding week of 1907, 121 in 1906, 137 in 1905 and 144 in 1904.

THE COPPER MARKET.

During the week which ended before the Labor Day holiday there was little evidence of any strength in the copper market. The main feature of the trading was a continuous pressure to sell which resulted in breaking prices. The Metal Exchange reduced its bid price ⅛ on all grades and there were rumors of outside trades at concessions under the quoted prices. In London the tone of the market is distinctly easier, and while the report is that there is a large short interest in the market, it is certain that the accumulations of actual metal are enormous and that the demand has not shown any considerable improvement. The British government has purchased about 200 tons for the Woolwich arsenal at something like 13.45 cents and the European agents have been freely offering metal at figures that would not net the American exporter more than 13⅜. These figures, however, do not prevent the continued export of copper. On Sept. 4 1678 tons left the Atlantic ports and exports for the month of September, including the date mentioned, were 1803 tons. The imports reported by the government for the month of July were only 6700 tons or 15,008,000 lb. An estimate made a month ago was 15,680,000 lb., but heavy arrivals were noted in August and September is likely to be even heavier. Since Jan. 1 the total imports have been 45,700 tons, or about 103,000,000 lb. During the first seven months last year the arrivals were 79,000 tons. The total importations by steamers and railroads—ores, matte and regulus reduced to fine copper—were as follows (in tons of 2240 lb.):

	1908.	1907.
January	7,300	10,700
February	8,600	9,800
March	6,400	12,700
April	7,300	11,240
May	3,300	11,810
June	6,100	9,150
July	6,700	13,600
Total for seven months	45,700	79,000

At the same time the production of metal by the American mines continues as active as ever. The production of the Butte mines for August was 25,317,700 lb. which, while it was 917,600 lb. below the July output, was 2,190,000 lb. more than for August, 1907, and with the exception of July and May was the largest monthly output for 1908. During the first eight months of the present year the Butte camp has produced a total of 152,926,320 lb. or about 75 per cent of the production for the same period last year. With the great reduction in cost of production already accomplished, and the general strength in the copper market, the Butte camp was able to treat last month a much lower grade of ore than during any previous month since operations were resumed. In this connection it is not out of place to refer to the general improvement in the condition of mining in the West. The mines are in better running condition than ever before in their history. Mr. S. J. Beahan, copper expert for the banking house of Hayden, Stone & Co., has returned from a two months' inspection of many of the leading Western copper mines. He visited the copper districts of Montana, Utah, Arizona and Mexico. Mr. Beahan says: "Copper conditions in the West show general improvement, and one of the strong features of the situation that came under my observation was the radical reduction in operating costs as a result of improvements, extensions, etc. While the condition of the copper market over the last 12 months has been distressing, still the forced closing of the mines was not without its good results as it gave the various companies an opportunity to reorganize their working forces, introduce economies, and to a great extent revolutionize methods of production which would have been impossible with the mines working to their respective maximum capacities." Prices quoted on the New York Metal Exchange Sept. 4 were:

Lake	13½ @ 13⅝c.
Electrolytic	13⅜ @ 13½c.
Castings	13⅛ @ 13¼c.

The London market was as follows:

	Noon.			Close.		
	£	s	d	£	s	d
Standard copper, spot	60	7	6	60	10	0
Standard copper, futures	61	2	6	61	5	0
Market	Steady.			Steady.		
Sales of spot	250 tons					
Sales of futures	600 tons					

Extreme fluctuations for the year:

	Highest.			Lowest.		
	£	s	d	£	s	d
Electrolytic copper, spot	13¾			12¼		
Lake copper, spot	13⅞			12⅜		
Casting copper, spot	13½			12⅛		
London, spot	64	5	0	56	5	0
London, futures	64	10	0	56	17	6
London, best selected	67	10	0	60	0	0

BIG DEAL REPORTED IN SAN FRANCISCO.—According to publications in various San Francisco newspapers, a deal has been closed for the acquisition of the Stanislaus Electric Power Company's property by the United Railroads of San Francisco, in which from $6,000,000 to $10,000,000 is involved. The Stanislaus Electric Power Company was conceived prior to the panic and the purpose of its promoters was to erect a large power and generating plant on the Stanislaus River. In order to finance the enterprise a contract was made with the Union

Construction Company to place its bonds. The Metropolitan Light & Power Company was the holding company for the Stanislaus Company and also for the San Francisco Coke & Gas Company. The bonds were largely placed and financed by the Knickerbocker Trust Company, of New York. After the suspension of the Knickerbocker Trust Company the project was allowed to rest, but now it is stated that powerful financial interests in New York and San Francisco which are interested in the United Railroads have become interested in the property and will develop it to its full possibilities. It is proposed to double the power development originally projected. It is said that the United Railroads will use all the power thus developed, and that the transportation company will thus be made independent of all other companies in the matter of being able to furnish all the power necessary for the propulsion of the cars in its present system, and will also be able to increase greatly its service and, if necessary, largely augment the number of cars for conveying passengers. Vice-President Charles N. Black, of the United Railroads, denied the deal had been consummated, but admitted that he had made a thorough examination of the Stanislaus property a month ago and would not deny that a deal was pending.

EDISON MANUFACTURING CONSOLIDATION.—Vice-President Frank L. Dyer of the Edison Manufacturing Company, Orange, N. J., announces that the business of the Battery Supplies Company, Newark, N. J., manufacturers of the Gladstone Lalande Battery and the newer type known as the Bsco battery, has been acquired by the Edison Manufacturing Company, together with all patents, right, etc., appertaining to the manufacture of those batteries. On September 1, 1908, the name of the Battery Supplies Company was discontinued, and that company is now absorbed and merged. The essential features of the Gladstone Lalande battery being similar to those of the Edison primary battery, and as the Gladstone battery elements were designed to be interchangeable with the Edison types, the Gladstone Lalande battery will be retired, and cells or renewals of the Gladstone Lalande battery should be ordered by the Edison types. The Edison Manufacturing Company will continue to make the Bsco 350-amp hour cell for railroad work, and in addition the same type of cell, with special low temperature electrolyte, for the same class of work at points where low temperatures affect the ordinary sodium hydrate electrolyte. The Bsco battery will also be manufactured in the 200-amp hour size, in two different styles; one with a liquid-tight, steel enameled jar, for portable engines and marines used on fresh water; the other with a liquid-tight porcelain jar, for use on launches running in salt water and on stationary engines.

DEMAND FOR PLATINUM STRONGER.—The platinum market is somewhat stronger than it has been for several months past, and there is evidence that the consumers are coming into the market. A representative of one of the largest firms handling platinum is quoted as saying: "While the price of platinum is still nominally from $18.50 to $19 per ounce, no large quantities could be bought at these figures. The market is strong and will be higher very shortly. Within the last few weeks there have been many inquiries for the metal and these were mostly from the large concerns that are the heavy users. As we understand it on this side, the stocks abroad are small and there is little likelihood, according to my view, that prices will go any lower."

SLAWSON-GRAHAM COMPANY.—Mr. J. Monroe Graham, treasurer of the Slawson-Graham Company, 24 Chambers Street, New York City, announces that it has sold out to the Thompson-Bonney Company, 45-47 York Street, Brooklyn, N. Y., its entire engine and dynamo repair business with plant. The Thompson-Bonney Company, Mr. John P. Bonney, secretary, states that the forces have been consolidated and that the new business will be carried on at York Street, and on a larger scale than before and that a stock of generators and motors will be carried.

THE NIAGARA FALLS ELECTRICAL TRANSMISSION COMPANY has transferred all its rights, titles and franchises to the Buffalo, Lockport & Rochester Railway Company, which in turn has contracted with the Niagara, Lockport & Ontario Power Company for supplying electricity for the new electric road, which was opened to the public on Saturday, Sept. 5. This deal eliminates the competition on Niagara Falls power, which has been anticipated in the section through which the Buffalo, Lockport & Rochester line is to operate.

Financial Intelligence.

THE WEEK IN WALL STREET.

The stock market for the short week which ended Sept. 4 was not indicative of any very important tendency. After strength and rapid advances there was some selling pressure with sagging prices. At the close of the week the net changes were largely losses although in many cases the gains in the first two days offset the later reactions. The only idea very strongly impressed by the course of the week's trading was that the market is as yet almost entirely professional. There are few outsiders buying orders and little stock heretofore held for investments is coming to light. The recent advances in prices resulted from manipulation on the part of strong interests who desire to peg the market high and keep it there and who have every facility for accomplishing this end without danger or undue trouble. Money is cheap and seeking investment, the supply of stocks to be had in the market is remarkably light and the fate of recent bear manipulators has not been such as to encourage conservative dealers to enter the market. Under these conditions the market has been advanced easily and from time to time traders have made profit. While the recent advances are said to be due to professional trading it does not indicate that there has been any such manipulation as the trading of the Saturday session which resulted in the downfall of the leading bear firm in the street. The professionals believe that the dividend paying stocks are destined to go higher and they figure that with time money at 3 per cent, a reasonably safe stock paying dividend in these times of depression may yield a profit. There is no lack of genuine optimism in the street and the desire, on the part of traders, to take profits when the advance is tempting does not mean a loss of faith in the ultimate higher figures. One of the features during the week under review, which caused a sharp break in the price of American Smelting common, was the publication of the list of stockholders of the company which failed to disclose many of the strong names that have been prominently identified with the enterprise. The large Republican plurality in Vermont last week was taken as indicating a victory for Mr. Taft, but the street is strikingly apathetic and a "political scare" between now and November seems extremely unlikely. One feature of the recent market that shows the general healthy condition of financial circles is the steady and persistent demand for good bonds. Trading is active and prices are steadily advancing. In the first eight months of 1908 the trading in stocks amounted to 26,000,000 shares less than for the same period in the previous year; in the same eight months there were $315,000,000 more bonds sold than in the corresponding period of 1907. Money is still plentiful and cheap. The rates Sept. 4 were 1 @ 1½ for call and 2 @ 2¼ for 90 days. The prices quoted in the table are those of the close on Sept. 4.

NEW YORK.

	Aug. 31.	Sept. 4.	Shares Sold.		Aug. 31.	Sept. 4.	Shares Sold.
All.-Ch.	11⅞	11½	500	Int.-Met., pfd.	34¼	32⅞	8,600
All.-Ch., pfd	36	35	320	Mackay Cos.	68	69	2,100
Amal. Cop.	81⅛	79⅛	116,010	MackayCos., pfd.	68¾	68	200
Am. D. T.	39*	39*	——	Manhattan Elev.	139⅜*	137	50
Am. Loc.	57½	54	22,320	Met. St. Ry.	34½*	34½*	——
Am. Loc., pfd.	106¾	105½	400	N.Y.& N.J. Tel.	112	115½	463
Am. Tel. & Cbl.	64½*	64½*	——	Steel, com.	47¼	46⅞	202,430
Am. T. & T.	127¼	131	47,000	Steel, pfd.	111⅜	111¾	42,790
B. R. T.	53⅜	54⅜	40,990	W. U. T.	55¾	57	1,300
Gen. Elec.	147¼	146¾	2,700	West'h, com.	78	75½	12,100
Int.-Met., com.	11⅞	11⅜	4,105	West'h, pfd.	95	95	200

PHILADELPHIA.

	Aug. 31.	Sept. 4.	Shares Sold.		Aug. 31.	Sept. 4.	Shares Sold.
Am. Rys.	45½	45	——	Phila. Elec.	9¾	9⅞	——
Elec. Co. of A.	10	9⅞	——	Phila. R. T.	14	14	——
Elec. Stor. B'ty.	38¾	38½	——	Phila. Traction.	—	89*	——
E. S. B'ty, pfd.	49*	49*	——				

CHICAGO.

	Aug. 31.	Sept. 4.	Shares Sold.		Aug. 31.	Sept. 4.	Shares Sold.
Chi. City Ry.	176½	176½*	——	Met. El., com.	16*	16*	——
Com. Edison.	107*	107*	——	Met. El., pfd.	43½*	43½	——
Chi. Subway.	20⅞	20½	——	Nat'nal Carbon.	72½*	72½*	——
Chi. Tel. Co.	147¾	148	——	Nat. Carb., pfd.	109	109*	——

BOSTON.

	Aug. 31.	Sept. 4.	Shares Sold.		Aug. 31.	Sept. 4.	Shares Sold.
Am. Tel. & Tel.	127½	131	——	Mass. E. R., pfd.	48	47	——
Comb'ind Tel.	175½*	175½*	——	Mex. Tel., pfd.	6*	6*	——
Gen. Elec.	148	146½	——	N. E. Tel'p.	118	120	——
Edison El. Ill.	230	235	——	W. Tel. & Tel.	7	7*	——
Mass. Elec. Ry.	9¼	9	——	W. T. & T., pfd.	70*	80	——

*Last price quoted.
Shares sold are for week Aug. 31 to Sept. 4.

BROOKLYN RAPID TRANSIT COMPANY'S REPORT.—The annual report of the Brooklyn Rapid Transit Company for the year ending June 30, 1908, shows an increase of $488,979 in gross earnings and only $15,105 in net earnings. The increase in operating expenses was $473,873, practically absorbing the increase in gross revenue. The total gross earnings for the year were $19,870,566, and the operating expenses were $11,939,578. After meeting fixed charges and taxes and expending $229,781 for additions and betterments the surplus left for the stockholders was $1,844,092, a decrease from the previous year of $158,506. This amounts to 4.1 per cent on the capital stock, in comparison with 4.45 per cent earned last year. The total profit and loss surplus of the company after making deductions for discounts and depreciation was $3,853,460. The most serious disadvantage the road encountered during the year was the heavy discount it was called upon to face in the sale of its 4 per cent refunding bonds. The $4,515,000 bonds that were sold brought only 67.73, making the net interest rate almost 6 per cent and causing a charge against the surplus of $1,457,173. The company was also compelled to pay high rates of interest for short-time loans, on account of the money stringency during the early part of its fiscal year. The report is considered to be a good showing, when the disadvantages under which the road labored are taken into consideration. The general business depression and large number of people out of employment curtailed travel, while the opening of the Interborough Rapid Transit Company's subway to the Long Island Railroad station diverted many passengers. The increase of the transfer system is also held responsible for causing a decrease in the road's earning capacity. In his report to the stockholders, Mr. Edwin W. Winter, president of the company, says: "There were carried 515,184,967 passengers for the fiscal year ended June 30, 1908, an increase of 3,345,530. The average gross earnings per passenger was 3.67 cents. The average cost per passenger carried was 2.25 cents, leaving an average net per passenger of 1.42 cents, from which must be taken all charges other than for operation. The average number of cars operated daily for the 12 months ended June 30, 1908, was 2203, an increase of 5.2 per cent. The average gross passenger earnings per car mile were 25.7 cents, as compared with 27.0 cents for the fiscal year ended June 30, 1907, a decrease of 4.8 per cent. The total number of trips run for the fiscal year ended June 30, 1908, was 6,148,774, an increase of 4.3 per cent over the corresponding period of 1907. The daily average number of passengers per car for the fiscal year ended June 30, 1908, was 639, a decrease of 4.6 per cent over the corresponding period ended June 30, 1907." Speaking of the extensions and development of the company's power stations, Mr. Winter says: "The extension of the Williamsburg power-station building to accommodate the additional units contracted for last year is practically completed. The capacity of the station has been increased 12,000 kw by the installation of one 10,000-kw turbo-generator unit and the enlargement of one 5500-kw turbo-generator unit to 7500 kw, and the necessary auxiliary equipment in connection therewith has been installed. Two additional high-tension feeder equipments and one additional set of exciters have been installed. The enlargement of the Williamsburg power station and construction of additional substations have enabled the company to discontinue the regular operation of the Third Avenue and Thirty-ninth Street (Brooklyn) power stations. These plants, however, will serve as reserve stations. The operation of the Brooklyn Bridge power station has been abandoned and the property turned over to the city by reason of the discontinuance of local service on the Brooklyn Bridge Railway. Six substations were completed and put in operation. The capacity of the bridge and Canarsie substations has been increased by 3000 kw and 1000 kw, respectively, the former building having been enlarged to provide for an ultimate capacity of 13,000 kw. The construction of proposed substations at Wyckoff Avenue and Palmetto Street, Ridgewood, and Thirty-eighth Street and Fifth Avenue (Brooklyn) has not yet commenced. Two and a quarter miles of underground conduits, or a total of 17.5 miles of duct, were constructed; 3.88 miles of high-tension feeder cables and 3.31 miles of low-tension feeder cables were installed in subway conduits. The length of overhead feeder wires was reduced by 8.5 miles, 63.5 miles of cable having been removed and 55 miles of cable erected. One hundred and twenty-seven miles of trolley wires were erected."

DIVIDENDS.

Chicago City Railway Company, quarterly, 1½ per cent, payable Sept. 30.

Philadelphia Traction Company, semi-annual, 4 per cent, payable Oct. 1.

Interborough Rapid Transit Company, quarterly, 2¼ per cent, payable Oct. 1.

Calumet & Hecla Mining Company, quarterly, 20 per cent, payable Sept. 29.

American Smelting & Refining Company, common, quarterly, 1 per cent; preferred, quarterly, 1¾ per cent; common, payable Oct. 15; preferred, payable Oct. 1.

Seattle Electric Company, preferred, semi-annual, 3 per cent, payable Oct. 1.

Canadian General Electric Company, common, quarterly, 1¾ per cent; preferred, semi-annual, 3½ per cent, payable Oct. 1.

Safety Car Heating & Lighting Company, quarterly, 2 per cent, payable Oct. 1.

Philadelphia Traction Company, semi-annual, 4 per cent, payable Oct. 1.

West Jersey & Sea Shore Railroad Company, common, semi-annual, 2 per cent, payable Sept. 15.

NEW STOCK FOR BOSTON EDISON COMPANY.—It is announced that the Edison Electric Illuminating Company of Boston will offer to its stockholders 9725 shares of new stock at $215 per share. The company has outstanding 125,436 shares and present holders will receive one share of new stock to every 13 shares now held. The proposed new stock issue is for the purpose of funding the floating indebtedness of the company which was created by expenditures for improvements and extensions demanded by its growing business. At present the stock is quoted in the neighborhood of $250 having advanced 20 points after announcement of the new stock issue was made. The business of the company has been increasing in spite of depressed conditions of trade.

TARRYTOWN, WHITE PLAINS & MAMARONECK.—Sutro Brothers & Company, of 44 Pine Street, New York, are calling for deposits of the 5 per cent bonds of the Tarrytown, White Plains & Mamaroneck Railway Company, due March 1, 1928, in order to obtain concerted action among the bondholders toward maintaining the integrity of the lien. An effort will be made to alter some of the contracts of the road in order to protect the interests of the bondholders.

PHILADELPHIA, BRISTOL & TRENTON BONDS.—The Sept. 1 interest on the $650,000 5 per cent bonds of the Philadelphia, Bristol & Trenton Street Railway has been defaulted. The company is controlled by the Interstate Railways Company and has not been profitable.

REPORTS OF EARNINGS.

	Gross Earnings.	Operating Expenses.	Net Earnings.	Charges.	Surplus.
Chicago Railways Company:					
June, 1908	$933,467	$645,924	$287,543	.....	.....
June, 1907	930,841	624,359	306,582	.....	.....
Interborough Rapid Transit Company:					
Year ended June 30, 1908	$19,870,566	$11,939,578	$7,930,988	$6,534,938	$2,073,873
Year ended June 30, 1907	19,381,587	11,465,705	7,915,882	6,026,387	2,444,661
American Smelting & Refining Company:					
Year ended April 30, 1908	$9,403,282	$1,769,995	$7,633,287	.....	$7,011,191
Year ended April 30, 1907	13,250,056	1,740,388	11,509,670	.....	9,914,254
Keystone Telephone Company, Philadelphia:					
Year ended June 30, 1908	$1,051,072	$499,123	$551,949	.....	$98,836
Year ended June 30, 1907	995,752	522,036	473,716	.....	107,740
Norway & Paris (Me.) Street Railway Company:					
Year ended June 30, 1908	$18,923	$7,108	$11,815	$4,920	$5,632

GENERAL NEWS

Construction News.

HUNTSVILLE, ALA.—A franchise has been granted E. S. Pulley to build an electric railway in Huntsville, Ala., on which active construction work will begin this month.

LINDEN, ALA.—J. A. Johnson and O. A. Johnson are reported interested in the construction of an electric light plant.

GLOBE, ARIZ.—N. L. Amster, of Boston, Ariz., has acquired the majority of stock in the Globe Electric Light & Gas Company.

PHOENIX, ARIZ.—Bids will be received until Sept. 30 by C. W. Goodman, superintendent Indian School, Phoenix, for furnishing, delivering and setting up in place ready to run at the Indian School, Phoenix, two 125-hp boilers, two oil pumps, a feed-water heater, a duplex steam pump, a smokestack and an electric motor.

MENA, ARK.—The Mena Electric Light & Power Company is extending its lines to the residential section of the city.

BISHOP, CAL.—The Mono Power Company is erecting a transmission line from its power plant site 15 miles north of Bishop to Silver Creek, Tonopah, Goldfield and Bullfrog, Nevada.

FRESNO, CAL.—The Kings River Power Company has filed papers appropriating 40,000 miners inches of water out of the Kings River.

JAMESTOWN, CAL.—The Union Construction Company has a large number of men engaged on a ditch and flume line for the Stanislaus Power Company. The forebay will be completed shortly and the installation of the electrical apparatus and water wheels is now going on in the power house. The penstocks will be completed within the next month. The steel transmission towers between the station and Mission San José have been erected and the work of stringing wires and mounting insulators is now going on. The power plant will be in operation, from present indications, in October.

OROVILLE, CAL.—According to M. A. Viele, general manager of the firm having in charge the construction of the plant of the Great Western Power Company, at Big Bend, water will be turned on through the tunnel before November. Work on the tunnel is progressing rapidly and a line of transmission towers has been completed between Antioch and Big Bend.

SONORA, CAL.—R. W. Hersey, of San José, who is interested in the Hersey Electric Company, of Tuolumne, has located a reservoir site in Tamarack Valley. Fifty thousand miners inches of water will be appropriated, and this will be conveyed by ditches and flumes to a point near the mouth of the Grapevine Gulch, and also at or near the mouth of the Moccasin Creek for the generation of electricity. The water will also be used for irrigation and other purposes.

TRINIDAD, COL.—The Southern Colorado Power & Railway Company has under contemplation the installation of 1000 hp in boilers, a 1500-kw turbo-generator and the erection of an 80-mile transmission line.

WASHINGTON, D. C.—The Potomac Electric Power Company contemplates the installation of a 9000-kw steam turbo-generator unit.

JASPER, FLA.—The Jasper Water & Light Company will install within a year a new generator rated at from 75 to 100 kw.

BARNESVILLE, GA.—The Allis-Chalmers Company, of Milwaukee, Wis., and the Fort Wayne Electric Company, of Fort Wayne, Ind., have been awarded contracts for improving the municipal electric lighting plant, the cost of which is estimated at about $7,000.

CHATSWORTH, ILL.—L. A. Walter, owner of the Chatsworth electric light plant, has purchased the Piper City electric light plant and will consolidate the two plants. The Chatsworth power station will furnish electricity for the two towns.

DARLINGTON, IND.—The citizens are reported to have voted to enlarge the municipal electric light plant.

HARTLEY, IA.—It is reported that bids will be received until Sept. 24 by the Town Clerk for installing an electric light plant, consisting of a gas producer, gas engine, dynamo, switchboard, storage battery and pole lines. E. B. Rich, engineer, Fort Dodge.

COFFEEVILLE, KAN.—The Coffeeville Electric Light & Power Company's plant will be enlarged in the near future. A Corliss engine and a 300-kw generator will be installed.

LEXINGTON, KY.—The electric lighting franchise of the city of Lexington is reported to have been sold on August 29 to the Kentucky Water, Heating & Illuminating Company, of Lexington, for $6,100.

BANGOR, MAINE.—The Bar Harbor & Union River Power Company has completed its line from the power station at Ellsworth to Bar Harbor. The line is 22 miles long, and where it crosses from the mainland to the island at Trenton Bridge steel cables are used. The transmission line poles are of steel.

BELLINGHAM, MASS.—The Selectmen have granted the Union Electric Light Company permission to erect poles and string wires from Woonsocket to Franklin, through Bellingham Center.

FITCHBURG, MASS.—The Fitchburg Gas & Electric Company has been granted permission to lay underground conduit in the streets of the city.

GARDNER, MASS.—The Gardner Electric Light Company has made an agreement with the Selectmen whereby the street lamps in the town will be lighted all night instead of until midnight, as heretofore.

MARLBORO, MASS.—It is stated that the Marlboro Electric Company has made a contract with the Connecticut River Power Company to purchase electrical energy from the latter company when its new hydro-electric station, now building at Vernon, Vt., is completed.

NORTH ABINGTON, MASS.—Arrangements are being made to abandon the local electric light station and to supply electricity for lighting the towns in this vicinity from the new Edison station at East Bridgewater. The local station will not be dismantled, however, but will be kept for emergency use.

NORTHAMPTON, MASS.—The Northampton Electric Lighting Company is installing two new boilers in its power house in order to insure sufficient steam supply for the engines in case of any interruption in the line from Turners Falls.

SALEM, MASS.—The Salem Electric Lighting Company is making extended improvements to its station. A new engine will be installed in the course of a few weeks and by November it is expected that the improvements will be completed.

SPRINGFIELD, MASS.—Durkee, White & Towne, architects, have completed plans for a proposed new power plant for J. J. Reddy. According to the figures of the engineers, it is possible to develop 500 hp from the water flowing in the brook near Bircham Bend.

TAUNTON, MASS.—The committee on street lamps has voted to remove naphtha lamps on the streets and to replace them with incandescent electric lamps.

WEST BOYLSTON, MASS.—The Marlboro Electric Company has made a proposition to the Selectmen to light the streets of the town with 40-cp incandescent lamps at the rate of $18 per lamp per year.

WEST MEDWAY, MASS.—At a special town meeting the Selectmen were authorized to make a contract with the Edison Company to equip and light the town with 210 lamps for a period of 10 years.

WILLIAMSVILLE, MASS.—The Williamsville Electric Light & Power Company is making extensive repairs and improvements to its dam, spillway and penstock, with a view to increasing the pondage and to obtain a maximum head of 31 ft.

CHATFIELD, MINN.—The Chatfield Electric Light & Power Company contemplates the erection of an auxiliary power house at the center of distribution. Steam-driven equipment will be installed.

POPLARVILLE, MISS.—The Poplarville Light & Water Works Company will have extensive improvements made to its electrical system; $10,000 has been appropriated to cover the cost of the work.

PURVIS, MISS.—The Purvis Light & Power Company, whose plant was destroyed recently by a tornado, contemplates rebuilding in the near future. The machinery can be repaired and the company is in the market for a small quantity of weatherproof and rubber-covered wire and electrical supplies.

CARUTHERSVILLE, MO.—The Caruthersville Ice & Light Company will add a dynamo to its generating equipment.

GREAT FALLS, MONT.—John G. Morony, Vice-Pres. Great Falls Water Power & Townsite Company, has announced that work will begin at once on the construction of a dam at Rainbow Falls, for the development of 23,000 hp. Henry A. Herrick, of the firm of Chas. T. Main, of Boston, Mass., is engineer; Frank A. Scotten, superintendent of construction. It is further reported that it is the intention of the company to commence work in the fall of 1909 on a second dam at the Great Falls of the Missouri. Chas. T. Main, mill engineer and architect, Boston, Mass., has been engaged for the engineering work in connection with the development of a large water power near Great Falls. It is reported that a dam will be built with 100-ft. head and that equipment will be installed for 30,000 hp, including wheels and generators.

KALISPELL, MONT.—The Flathead Valley Water Power Company is building a transmission line to Whitefish, Mont. The line is 18 miles long and will carry electricity at a tension of 32,000 volts.

CLARKSON, NEB.—J. P. Brown, of Fremont, Neb., is reported to have secured the contract for constructing the municipal light plant.

UNIVERSITY PLACE, NEB.—The municipal plant has made a contract with the Lincoln Traction Company to purchase electrical energy at 4 cents per kw-hour, delivered at the station. The contract is made for five years, and the municipality will install two three-phase, 60-cycle motors for driving the pumps furnishing water for the city supply, and will erect a 2300-volt, 60-cycle, single-phase line for street lighting.

CONCORD, N. H.—The Bridge Street station of the Concord Electric Company has been dismantled and the machinery is now being installed in the new station at Sewall's Falls.

NASHUA, N. H.—The dam which the Nashua Light, Heat & Power Company is building across the river has been completed.

PLYMOUTH, N. H.—There is a popular desire on the part of the community to procure an electric street lighting equipment.

ALBANY, N. Y.—The State Armory Commissioners will receive sealed bids until 12 M. Tuesday, Sept. 15, 1908, when bids will be opened and publicly read for installing electric conduit, wiring and fixtures in the State Armory Building at Poughkeepsie, N. Y. Plans and specifications may be seen and bidding sheet secured at the State Armory, Poughkeepsie, or at the office of the State Board of Armory Commissioners in Albany.

AUBURN, N. Y.—The Auburn Light, Heat & Power Company (M. C. Turpin, Superintendent) is arranging to double the output of its North Street power plant; the present boilers are to be removed and a triple set of boilers of large capacity are to be installed.

BINGHAMTON, N. Y.—The Binghamton Railway Company (J. P. E. Clark, general manager) is arranging to extend its electric transmission lines to Westover, Hooper and Lestershire, to furnish the said towns with electricity for lamps.

BUFFALO, N. Y.—J. J. O'Leary, electrical engineer, 62 Niagara Street, Buffalo, N. Y., has been jointly retained by the Common Council of the City of Buffalo and the Board of Supervisors of Erie County to prepare plans and specifications for installing a private electric generating plant and electric wiring in the city and county building, which at present is lighted by gas only. It has not yet been definitely determined whether the installation will consist of gas-engine or steam-engine driven units. The units will be direct-connected and rated at 75 kw or 100 kw each.

BUFFALO, N. Y.—The Buffalo General Electric Company, C. R. Huntley, general manager, P. F. Sellers, electrical engineer, 702 Fidelity Building, Buffalo, N. Y., will erect a new substation in the town of West Seneca, N. Y., for the purpose of transforming energy from Niagara Falls to be used for street lighting. One hundred and fifty magnetite lamps are to replace the 6.6 amp series direct-current lamps formerly used for lighting the villages of West Seneca and Blasdell. Installation will be made by company's construction department and will consist of three 125 kw oil-cooled transformers, three 50-light magnetite lamp circuits, mercury arc system, switchboard and other accessories. Electricity will be delivered to the transformer station at a tension of 12,000 volts and will be stepped down to 2200 volts.

CANAJOHARIE, N. Y.—It has been voted to spend $2,800 for constructing a 15-duct conduit from the canal bridge to the northerly end of Mill Street, for the purpose of providing underground accommodations for all public service wires and cables along Church Street.

FISHKILL LANDING, N. Y.—A power plant is to be built on Academy Street by Van Houten Bros. for the purpose of supplying electricity to a number of manufacturing establishments, the principal of which will be the Dutchess Tool Company, which will at once equip its entire plant for motor drive.

NEWBURGH, N. Y.—The Newburgh Light, Heat & Power Company, Wm. R. Beal, general manager, has made application to the Public Service Commission for permission to issue convertable debenture bonds to the amount of $350,000. Of this amount it is proposed to use $25,000 for placing a number of its transmission lines and conduits under ground; $18,000 for extending the transmission lines to Ashokin for supplying electricity in that section; $39,930 for additional equipment and improvements to the power plant at Newburgh; $100,000 for erecting new transmission lines, and the balance in purchasing the properties of the Hudson Counties Gas & Electric Company and the supply of electric energy generated at Honks Falls.

NEW YORK, N. Y.—Bids will be received until Sept. 17 by the Commissioners of Parks (Henry Smith, President), New York City, for furnishing and delivering at the American Museum of Natural History seven electric motors and electric cables.

ONEONTA, N. Y.—The Board of Trustees will soon call for bids for the lighting of the streets of Oneonta with 80 or more arc lamps for a period of five years, beginning with March 1, 1909.

TONAWANDA, N. Y.—The Tonawanda Power Company, F. M. Gordon, general manager, North Tonawanda, N. Y., has the contract for supplying the energy for operating three 500-hp motor-driven centrifugal pumps which are now being installed by the city of Lockport on the banks of the Niagara River, for the purpose of forcing water through a 36-in. pipe line from the Niagara River to the city of Lockport, a distance of 12 miles. Electricity is received from Niagara Falls at a voltage of 22,000 and transformed to 4400, at which it is used.

YONKERS, N. Y.—Sealed bids will be received by Chauncey T. Secor, chairman of the building committee of the Board of Supervisors, Yonkers, N. Y., until 2 p. m., Sept. 10, for electrical equipment, boilers and engines, wiring, switchboard apparatus, etc., to be installed in the new court building and hall of records, under construction at Yonkers.

GASTONIA, N. C.—The Western Electric Company has been awarded the contract for electrical machinery to be installed at the Loray cotton mills at Gastonia, N. C. The contract was awarded by engineers of the Southern Power Company, of Charlotte, N. C., which will furnish the electrical power to be used in operating the mills. The installation of the machinery will require about 60 days. The cost of the machinery is estimated at about $65,000. About 3000 hp will be used.

CHINA GROVE, N. C.—Transmission lines are being erected preparatory to using electricity from the Southern Power Company for lighting the town.

SALISBURY, N. C.—The Salisbury-Spencer Electric Railway Company began on Aug. 29 to operate its system by electrical power supplied by the Southern Power Company from a plant 50 miles distant. Within a short time the Southern Power Company will supply all the electricity used in the towns of Salisbury and Spencer through the local electric railway company.

COLUMBUS BARRACKS, OHIO.—Bids will be received until Sept. 15 by Capt. H. J. Hirsch, construction quartermaster, United States Army, Columbus Barracks, for furnishing and installing electric light fixtures, meters, etc., and making service connections to the Post Hospital at this post for lighting.

MINERVA, OHIO.—Bids will be received until Sept. 24 by L. E. Weber, secretary of the Board of Public Service, for a 150-hp boiler, 150 lb. steam pressure, for the municipal electric light and water plant.

AIKEN, S. C.—The Solomon-Norcross Company, of Atlanta, Ga., is reported to have been selected to make surveys and estimates for an electric light plant.

CHARLESTON, S. C.—Bids will be received until Sept. 15 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing two electric motors at the Charleston Navy Yard as per Schedule 290. E. B. Rogers is paymaster-general, United States Navy.

SCOTLAND, S. D.—The question of constructing an electric light plant is reported under consideration.

NATIONAL SOLDIERS' HOME, TENN.—It is stated that bids will be received until Sept. 28 by Paul E. Devine, treasurer, Mountain Branch, N. H. D. V. S., National Soldiers' Home, for furnishing material and installing additional arc lamps.

EL CAMPO, TEX.—The El Campo Light, Ice & Water Company is reported to have increased its capital from $10,000 to $20,000. Extensions will be made.

HOUSTON, TEX.—The Brunner Water & Light Company has applied for a state charter. The capital stock of the company is $50,000, of which $10,000 is paid in. The company contemplates erecting a water and light plant sufficient for the needs of a city of 10,000 inhabitants. Work is expected to begin by the first of November.

WEATHERFORD, TEX.—The City of Weatherford Water, Light & Ice Company will install a 150-hp vertical gas engine, together with a producer using lignite as fuel.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has began the work of installing an underground system, as provided in a recent ordinance. About 50,000 ft. of cable will be laid.

BROOKE, VA.—Austin Run Mining Company, 507 Harrison Building, Philadelphia, Pa., is reported to be planning to install a power plant at Brooke for operating its iron pyrites mines; the plant will include 70-hp steam engine, 100-hp boiler, air compressor, air drills, hoisting engine, etc.

EMPORIA, VA.—The Greenesville Light & Water Company is reported to be planning to begin construction of a water power electric plant to transmit electricity for lamps and motors; surveys have been made, and estimates include a 36-ft. dam across Meherrin River, one mile from Emporia, which will develop 1400 hp. W. Samuel Goodwyn, of Emporia, is president. C. P. E. Burgwyn, of Richmond, Va., is engineer.

RICHMOND, VA.—The Virginia Passenger & Power Company will furnish electricity for lighting the Central State hospital buildings. About 800 lamps will be required.

KEWAUNEE, WIS.—Bids were opened Aug. 27 by W. Wiesner, city clerk, for constructing an electric light plant, to comprise, in the main, a brick building, pole line and wiring, one 50-kw, two-phase, alternating-current dynamo, arc light equipment and 85-hp, high-speed, compound condensing steam plant, and contracts have been awarded as follows: To the Albrecht Manufacturing & Supply Company, of Kewaunee, at $5,360, and the Langstaedt & Meyer Construction & Supply Company, of Appleton, Wis., at $12,870. Oscar Claussen, St. Paul, Minn., is engineer.

EDMONTON, ALB., CAN.—The City Council has purchased the charter of the Strathcona Radial Tramway Company for operating an electric street railway system in the town of Strathcona. The price paid was $10,000, and in addition debentures will be issued for $135,000 to defray the cost of the construction of a municipal street railway in this city, work on which will be commenced this fall. For further information, address Superintendent McLean.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railroad Company offers to build street car extensions through Hastings upon receipt of a bonus of $51,000. R. H. Sperling is general manager.

CHATHAM, ONT., CAN.—The franchise of the Bell Telephone Company expires this year, and it is said that the Blenheim & South Harwick Company is ready to enter the city and give a telephone service at a much lower rate. The new company offers to lay its wires underground in addition to furnishing a telephone service at a reduction of $10 per annum from the rates of the Bell company.

HAMILTON, ONT., CAN.—The fire, water and light committee has decided to ask for tenders for synchronous motors of 66 cycles for the beach pumping stations. All the tenders received were on induction motors except one, on a 25-cycle motor, which could not be used with the cataract power.

PORT ARTHUR, ONT., CAN.—Seaman & Pananen have been awarded the contract for construction of the dam on the Current River, for $18,000. It will be 25 ft. high and 300 ft. long. J. McTeigue is city clerk.

TORONTO, ONT., CAN.—W. D. Bearmore has issued a writ to prevent the city going on with the hydro-electric contract.

TORONTO, ONT., CAN.—Smith, Kerry & Chase will superintend the construction under the hydro-electric transmission line, the contract for which was awarded to F. H. McGuigan & Company.

SHERBROOKE, QUEBEC, CAN.—The Sherbrooke Power, Light and Heat Company is installing a 400-kw, three-phase generator. This is direct connected to a water-wheel.

REGINA, SASK., CAN.—The contract for the building of the Government long-distance telephone line from Regina to Antler, a distance of 220 miles, has been let to the Moosejaw Telephone Company, of Moosejaw, Sask., at $79.50 per mile.

SASKATOON, SASK., CAN.—The tender for the construction of the Government long-distance telephone line from Saskatoon to Lumsden, a distance of 180 miles, has been awarded to J. S. Bartleman, Regina, Sask., for $79.75 per mile.

ORIZABA, MEX.—The Compania de Luz Electrica y Fuerza Motrig de Orizaba will install generating equipment aggregating 500 kw.

New Incorporations.

ST. ANDREWS, FLA.—The St. Andrews Ice & Power Company, of St. Andrews, is reported incorporated, with a capital of $25,000. J. H. Drummond, president; T. J. McSween, secretary and treasurer.

CRAWFORDSVILLE, IND.—The Pleasant Shades Power Company, of Crawfordsville, is reported incorporated; capital, $100,000; directors, Mitchell M. Ewers, Isaac E. Ewers and Henry Van Cleave.

MORGANTOWN, IND.—The Morgantown Light & Power Company, of Morgantown, has been incorporated; capital, $5,000; directors, W. J. Gibson, Jesse H. Dee and Wm. W. Davis.

JERSEY CITY, N. J.—The Haytian Electric Company, of Jersey City, is reported incorporated, with a capital of $100,000, by L. M. Arthur, S. H. Parsons and J. L. Egan, to manufacture, generate, etc., electric current for heat, power and light.

BUFFALO, N. Y.—The Erie & Ontario Sanitary Canal Company, of Buffalo, was incorporated at Albany on Aug. 28, with a capital of $100,000. The purpose of the company is to build a canal which shall utilize the fall of 326 ft. between Lake Erie and Lake Ontario for sanitary disposal of Buffalo and Niagara frontier sewage; aid abatement of floods in South Buffalo; serve as a branch of barge canal; furnish light and power for municipal and industrial uses and provide almost unlimited dockage. Directors: Millard F. Bowen and Irving L. Pruyn, of Buffalo; Edw. H. Taylor, of Niagara Falls, and Thos. S. Munsill, of Batavia.

CORPUS CHRISTI, TEX.—The People's Light Company, of Corpus Christi, is reported incorporated; capital, $30,000; incorporators, Clark Pease, John G. Kennedy, Geo. A. Blucher and Thomas E. Craig.

STAUNTON, VA.—The Shenandoah Electric Company has been organized with a capital stock of $10,000. The officers are: P. H. Trout, president; M. W. Mercereau, vice-president, and Edward Woodward, secretary and treasurer, all of Staunton.

CHEYENNE, WYO.—The Citizens' Water & Power Company of Wyoming, which proposes operating in Teller and El Pasco Counties, is reported incorporated, in Cheyenne, by G. A. Taff, G. M. McMahon and R. L. Holland; capital, $1,000,000.

Legal.

INJUNCTION.—The case of A. C. Wishon vs. the Globe Light & Power Company, the Mt. Whitney Power Company, has been decided in favor of the first-named company. The suit was brought to secure an injunction against the two other companies enjoining them from building dams and carrying on other work necessary for a diversion of water for power purposes, the plaintiffs claiming a prior appropriation.

THE ASHEVILLE RAPID TRANSIT COMPANY IN RECEIVER'S HANDS.—Upon application of the Asheville Electric Company, and other creditors, Judge Ward, of the Superior Court, has placed in the hands of a receiver the Asheville Rapid Transit Company, of Asheville, N. C., J. P. Arthur being named receiver. The above step is declared to be the initial move in an effort to oust the present owners and restore the property to R. S. Howland and his associates. Mr. Howland holds first mortgage bonds, given him in part payment for the lines when Mr. Van Bibber and associates purchased the plant. Mr. Howland is building an 8-mile extension to Weaverville.

COMPANY HELD LIABLE FOR DAMAGES DUE TO CROSSED WIRES.—An action was brought to recover damages for the loss of a team of horses alleged to have been caused by the carelessness of the defendant corporation in negligently failing to exercise and use proper care in operating its electric light plant and system of appliances, and negligently putting in the plaintiff's livery barn dangerous and defective wires, without proper fuses or proper insulation. It appeared that the wire entering the plaintiff's barn became crossed with a wire more heavily charged, and by reason of the current thus introduced into the barn the wire broke, and in falling came in contact with and killed the plaintiff's team of horses. The plaintiff testified that, as soon as he discovered that there was trouble, he tried to get the company's office by telephone, but could not, and then went to the office and station of the company, but found no one there. He tried several times to find some one who could open the circuit, but without success. It was held that the company was guilty of negligence and was liable for damages. Younie vs. Blackfoot Light & Water Company, Supreme Court of Idaho, 96 Pac. 193.

RIGHT OF ELECTRIC COMPANY TO ACQUIRE LAND BY EMINENT DOMAIN.—The taking of land for a right of way for a ditch or flume to convey water to an electric plant to be utilized to generate electricity for sale to the public for lighting, heating and industrial purposes, is a public use within the meaning of the eminent domain statutes, and an electric company may exercise the right of eminent domain to acquire property for such purposes. There can be no doubt that the furnishing of electricity is a use for which the Legislature intended that the right of eminent domain might be exercised. The purpose of statutes is to remove obstacles in the way of development and progress in the State. The Legislature cannot by its enactments consider as a public use what is essentially a private use, and the question whether the use is public in its nature is a judicial question, to be determined by the courts. It is the general rule, however, that where it is uncertain and doubtful whether the use to which the property is proposed to be devoted is of a public or private character, the legislative determination of the question is of persuasive force, and the courts will not undertake to disturb the same. Moreover, it has been generally held by the courts that the generation of electric energy for distribution and sale to the public on equal terms is a public enterprise, and that water used for that purpose is devoted to a public use. In Light & Power Company vs. Hobbs, 72 N. H. 531-535, 58 Atl. 46, 66 L. R. A. 581, the court said: "Like water, electricity exists in nature in some form or state, and becomes useful as an agency of man's industry only when collected and controlled. It requires large capital to collect, store, and distribute it for general use. The cost depends largely upon the location of the power plant. A water power having a location upon tide water reduces the cost materially. It may happen that the business cannot be inaugurated without the aid of the power of eminent domain, or acquisition of necessary land or rights in land. All these considerations tend to show that the use of land for collecting, storing, and distributing electricity to all who may desire it is a public use, similar in character to the use of land for collecting, storing, and distributing water for public needs—a use that is so manifestly public that it has been seldom questioned, and never denied." Walker vs. Shasto Power Company, United States Circuit Court of Appeals, 160 Fed. Rep. 856.

Personal.

MR. W. L. GARRISON, JR., and MR. PHILIP S. DALTON have been admitted to partnership in the well-known Boston banking and bond firm of Perry, Coffin & Burr.

MR. FRANK M. COZZENS, of Saratoga, N. Y., has been appointed district manager of the Hudson River Telephone Company, at Schenectady. Mr. Cozzens was the special agent of the telephone company at Saratoga and succeeds Mr. Harry M. Cohen.

MR. WALTER T. SCHWABE, who for many years has been local superintendent of the Rutherford, N. J., substation of the Public Service Corporation, has been appointed general manager of the Northern Connecticut Light & Power Company, of Thompsonville, Conn.

D. C. & W. B. JACKSON, engineers and experts, announce that they have removed their Western office from Madison, Wis., to the Commercial National Bank Building, Chicago, where Mr. W. J. Crumpton will be in charge. Their Boston office is in the India Building, State Street.

MR. FREDK. MARTIN SHORT, A. I. E. E., of the firm of Balmer, Lawrie & Company, Calcutta, India, has been visiting the United States on his way to England, for which country he sailed on Sept. 5. While here Mr. Short visited factories where apparatus is made handled by his firm, and he also looked into the incandescent lamp situation.

MR. PARKER H. KEMBLE, president of the Northern Connecticut Light & Power Company, will sever his connection with that company on Sept. 16. Mr. Kemble will take a six-weeks' vacation, after which he will take charge of experimental work in connection with Burdeth Loomis, of Hartford, who is interested in the Northern Connecticut Light & Power Company.

BRIG.-GEN. JAMES ALLEN, Chief of the Signal Corps, of the United States Army, sailed for France on the American liner *St. Paul* on Sept. 5. Gen. Allen will immediately, on his landing at Cherbourg, proceed to Marseilles, where he and Commander Chapin of the navy will represent the United States at the conference which is to consider wireless telegraphy, wireless telephony and aeronautics.

DR KARL GEORG FRANK has arrived in this country and will henceforward be the representative here of the Siemens & Halske Company and the Siemens-Schuckert Works, of Berlin, Germany. Dr. Frank has been in the United States before and has an acquaintance here. He has opened offices in Room 1559, Hudson Terminal Building, New York City. Dr. A. Raps, of the same company, is expecting to pay another visit to America, in October.

MR. F. H. McGUIGAN.—As noted recently in these pages, the Hydro-Electric Power Commission of Ontario, Can., has accepted the tender of the F. H. McGuigan Construction Company for the building of some 300 miles of its transmission lines in Southwestern Ontario. Mr. McGuigan is well known in Canada and in the United States as a successful railway man, whose executive capacity has been proved through many years of relationship with the Grand Trunk, the Great Northern and other roads. He has engaged the services of the engineering firm of Smith, Kerry & Chace, of Toronto and Winnipeg, to carry out this work now allotted to him, this firm having rendered him material assistance in the preparation of the tender now accepted. Mr. C. B. Smith has been intimately acquainted with the work of the Hydro-Electric Power Commission since its inception. He was chief engineer of the first Provincial Commission and for a period a member of the second, the present Commission. He is thus eminently fitted to advise Mr. McGuigan in his handling of this extensive contract.

Obituary.

MR. B. F. ELLISON, general manager of the Superior Water, Light & Power Company, died at Superior, Mich., Sept. 1, of a complication of diseases from which he had suffered grievously for some time. Mr. Ellison had been manager of the Superior company for the past nine years, having previously been connected with the gas company of St. Paul, and prior to going West he was an employee of the New York Central Railroad. Mr. Ellison was born in Utica, N. Y., 55 years ago, and is survived by a widow and four children.

Educational.

CARNEGIE TECHNICAL SCHOOLS.—Of the four schools that for apprentices and journeymen will open on Oct. 5, the other three opening on Sept. 21. In the latter schools instruction is given in applied science, applied design and in subjects especially arranged for women. Day courses and night courses are offered in each school.

UNIVERSITY OF ILLINOIS.—Vol. V, No. 14, of the *Bulletin* of the university is devoted to the College of Engineering, illustrations being given of the work and equipment of the various departments. It is shown by charts that the total enrollment of students in the College of Engineering has increased from 273 in 1898 to 1265 in 1908.

LEWIS INSTITUTE.—The Lewis Institute, Chicago, Ill., announces for the year 1908-9 courses in the following subjects: Mechanics, arts, engineering, mathematics, physics, chemistry, physiography and geology, physiology and bacteriology, domestic economy, history and economics, psychology and philosophy, English, German, French, Latin, decorative art, physical culture and athletics.

POLYTECHNIC INSTITUTE OF BROOKLYN.—The institute offers courses in chemistry and chemical engineering, civil engineering, electrical engineering and mechanical engineering. Including 64 graduate students, there was a total enrollment last session of 557 students, exclusive of 258 students in courses given under the joint auspices of the Brooklyn Teachers' Association and the Polytechnic Institute.

Trade Publications.

PUMPS for every service are described in a booklet issued by the Goulds Manufacturing Company, Seneca Falls, N. Y.

AIR COMPRESSORS for all services are well illustrated and described in Catalogue No. 26 of the Chicago Pneumatic Tool Company, Chicago, Ill.

FUSES.—The Sachs Company, Hartford, Conn., has issued a 56-page booklet listing and describing enclosed fuses and other standard circuit protecting devices.

DIRECT-CURRENT MOTORS, rated at from 1 hp to 100 hp, are illustrated and described in Bulletin No. 159 of the B. F. Sturtevant Company, Hyde Park, Mass.

LAMP CORD for hanging arc lamps is discussed in a leaflet which accompanies samples of "Samson Spot" cord being distributed by the Samson Cordage Works, Boston, Mass.

METAL REFLECTORS.—The August issue of *Holophane* announces the introduction by the Holophane Company, 227 Fulton Street, New York, of a line of metal reflectors, designed by Mr. Henry D'Olier, Jr.

PUSH BUTTON SPECIALTIES, including pendant switches and lamp sockets containing its three-part switch mechanism, are described in a booklet recently issued by the Cutler-Hammer Mfg. Co., Milwaukee, Wis.

RECORDING THERMOMETERS adapted for registering temperatures of air, gas or liquids in tanks, pipes, mains, closed spaces ,cold storage and drying rooms, are discussed in Bulletin No. 91 of the Bristol Company, Waterbury, Conn.

AIR PUMPS, Bulletin No. 100 of the Wheeler Condenser & Engineering Company, West Street Building, New York, deals with the Edwards air pump, which is stated to be able to maintain a vacuum of from 28.6 to 29.0 in. of mercury.

MOTORS.—The Triumph Electric Company, Cincinnati, Ohio, has issued a booklet entitled "The Way to Forget," which suggests the use of Triumph generators and motors as an aid in forgetting the existence of troubles with electric machinery.

INDUCTION MOTOR STARTERS.—Supply parts for starters of the variable-voltage type are illustrated in supplements to its instruction book No. 5007, issued by the Allis-Chalmers Company, Milwaukee, Wis. These parts refer to starters designated A1, A2, B1 and C1, respectively.

CONDENSERS.—The Alberger Condenser Company, 95 Liberty Street, New York, has issued a well-printed, neatly-illustrated 96-page catalogue devoted to steam condensers of the barometric, central, centrifugal, counter-current surface, standard surface and base types. The operation of each of these condensers and the auxiliary devices are fully discussed.

INDICATORS for steam, gas and oil engines are thoroughly discussed in a 70-page catalogue issued by the American Steam Gauge & Valve Manufacturing Company, Boston, Mass. An interesting attachment for these indicators consists of an electromagnetic device which enables an operator to obtain cards simultaneously from any number of cylinders.

RECORDING ELECTRICAL INSTRUMENTS.—Bulletin No. 88 of the Bristol Company, Waterbury, Conn., illustrates and describes recording ammeters, voltmeters and wattmeters of both the switchboard and portable types. The wattmeters are real recording instruments, and are not to be confused with watt-hour meters that are sometimes erroneously referred to as recording wattmeters.

WIRES AND CABLES.—A valuable handbook dealing with wires, cables and cordage has been issued by the Belden Manufacturing Company, Chicago, Ill. This book is a 124-page publication, filled with specific information concerning cotton, silk and enamel insulated wires, resistance wires, braided copper cables, tape, insulating compounds, etc. Much data dealing with wires and wiring are presented in convenient form.

PORTABLE HEATERS, used by electric railways for removing and renewing steel center plates in switches and cross-overs, sweating bonds on rails, etc., are described in a well-illustrated bulletin issued by the Rockwell Furnace Company, New York, N. Y. A special catalogue of the same company is devoted to furnaces for melting any kind of metal, for tinning, galvanizing, tool hardening, and any operation requiring molten metal or other heated baths.

Business Notes.

JENNEY ELECTRIC MANUFACTURING COMPANY, of Indianapolis, Ind., has opened a Boston office at 202 Equitable Building, in charge of Messrs. A. F. Jenney and F. H. P. Lowe.

METER INSPECTION.—The Mutual Inspection & Adjustment Company, 143 Liberty Street, New York, of which Messrs. C. J. Koller and L. C. Kinney are members, is organized to undertake testing meters for central stations in any part of the country, and has issued literature on the subject.

SECOND-HAND APPARATUS.—Mr. George Bender, dealer in dynamos and motors, has removed to larger quarters at 82-84 Centre Street, New York City, where he is carrying a large stock of second-hand dynamos and motors. The business has been in existence since 1897.

THE POWER EQUIPMENT COMPANY, with offices at 50 Church Street, New York City, and a capital stock of $50,000, has been formed for the purpose of handling the Eastern sales of the Skinner Engine Company's engines, of Erie, Pa., and the Union Iron Works boilers, of the same city.

STERLING VARNISH.—Mr. H. W. Turner, who has for the past two years been engaged in consultation as to matters in England relating to insulation and winding, will hereafter be associated exclusively with the Sterling Varnish Company, at Brougham Street, Blackfriars Road, Manchester, England.

THE CENTRAL ELECTRIC COMPANY, Chicago, reports that its incandescent lamp sales for the first half of the present year are more than double its sales for the corresponding period of 1907. It attributes this partly to the fact that it carries a good Chicago stock for immediate shipment of all standard voltages and candle powers of high efficiency units such as Columbia tungsten and tantalum lamps, as well as Columbia carbon-filament lamps, and partly to the superior quality of Columbia products.

AMERICAN CIRCULAR LOOM COMPANY announces that its new factory at North Cambridge, Mass., is now ready and is equipped throughout with modern and improved machinery for the manufacture of "Circular Loom" product, for electrical wiring purposes. The plant is already in full operation and all orders can be filled promptly. The company's old high standard of quality and excellence will be maintained and heightened by new methods and advanced processes of manufacture.

BUCKEYE LAMP CONFERENCE.—The Buckeye Electric Company, Cleveland, Ohio, has just finished the most successful annual conference and meeting of the staff in its history. During the last week of August, 15 branch managers and salesmen and 10 interested guests took part in the meeting, when every question relative to the incandescent lighting art and industry was thoroughly discussed. Excellent results are expected to the company and its customers. It is stated that the company's orders for August, 1908, were at least 20 per cent larger than in August of the previous year.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED SEPT. 1, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

897,273. TROLLEY-CATCHER; Michael G. Delaney, Detroit, Mich. App. filed Aug. 30. 1907. A trolley retriever having a rigid wheel and a magnetically operated detent to lock the wheel against movement in case the circuit of the car motor is interrupted by the wheel leaving the trolley wire.

897,275. WIRELESS TELEGRAPHY; Reginald A. Fessenden, Washington, D. C. App. filed Oct. 6, 1906. In signaling apparatus an inductive coupling, and a receiver placed in the secondary of the coupling, and within influence of the primary so that the primary acts to shield it from disturbing influences.

897,280. AUTOMATIC STOKING-INDICATOR MECHANISM; Robert Forsyth and William W. Hanscom, San Francisco, Cal. App. filed Sept. 15, 1904. Means for operating signals or indicators located in one or more furnace rooms adjacent to the furnaces or boilers, adapted to indicate when a coal supply is required and certain other conditions in the care of the boilers.

897,289 BREAST PUMPING MACHINE; Truman W. Howell, Mabton, Wash. App. filed March 22, 1907. In a breast pump, a breast member comprising a single piece structure and including a hollow body, a mouth at one end, a depending vessel, transversely extending walls within the body at the rear of the vessel, and a neck for connection with a pump.

897,291. METHOD OF RENDERING ELECTROLYTIC COPPER HOMOGENEOUS; Marcel Andre Jullien and Emile Louis Dessolle, Levallois-Perret, France. App. filed April 4, 1907. A method of rendering electrolytic copper absolutely homogeneous, so that it has the same resistance and the same tensile strength in every direction. Makes use of polishers having a peculiar movement in the electrolytic vat, and which are operated during deposition.

897,300. ELECTRIC-CABLE LAMP; Ernest W. Muller, Brooklyn, N. Y. App. filed Feb. 8, 1908. Makes use of a pair of trianguiar plugs with ribbed surfaces which are drawn longitudinally so as to tightly wedge the cable between them.

897,304. CONTINUOUS TRACK-LIGHT AND AUTOMATIC SIGNAL; John M. Pitney, Jr., Lorain, Ohio. App. filed May 11, 1908. Patentee has a tail light for a train with a chain connection to the rear trucks, so as to be properly directed when the train is passing around a curve.

897,312. ELECTRIC LOCOMOTIVE; Elmer A. Sperry, Brooklyn, N. Y. App. filed Feb. 7, 1908. A coupling connection for the motors of an electric train which are concentrically arranged on the car axles. Is designed to prevent unequal rail pressure from cutting down or impairing tractive effort.

897,318. OZONIZER; Jan Steynis, New York, N. Y., and Henri Chaumat, Paris, France. App. filed March 6, 1907. An ozonizer having two series of metal plates alternately connected to the electrodes, one series of plates being stationary and the other movable.

897,326. ELECTRIC HEAT UNIT OR DEVICE; George H. Wade, Atlanta, Ga. App. filed March 9, 1908. A heating unit formed with a plurality of layers and an electrical conductor positioned between said layers to cause the heat of the electrical conductor to be projected in parallelism with the plane of said layers.

897,350. ELECTRIC STOP-MOTION FOR MOTORS AND SIGNAL FOR THE SAME; Adam Cochrane, Lowell, Mass. App. filed March 21, 1908. A means for shutting off the flow of steam to a steam engine or water-wheel by closing an electric circuit when the engine or wheel approaches a dangerous speed. Has an indicator in constant motion to show the attendant that the current is available in the circuit.

897,355. ELECTRIC BLOCK-SIGNALING SYSTEM; John W. Davis, Los Angeles, Cal. App. filed Sept. 20, 1907. Complete mechanical and electrical features of a signal system having sectional track rails energized by direct current and a cab signal, completed at intervals by wire brushes depending from the trucks into engagement with a contact rail.

897,394. ELECTROMAGNETIC LOCKING DEVICE; Charles O. Peters, Winthrop, Mass. App. filed March 30, 1908. A magnetic door-lock having a rotatable latch which is tripped to release the door by an electromagnet.

897,401. ELECTRIC SIGNALING SYSTEM; Harry C. Reagan, Butler, Pa. App. filed May 27, 1907. A signaling system for trolley railroads having a signal wire and a train stop operated through said signal wire for drawing the current-collecting device on the car away from the trolley wire.

897,402. TROLLEY-FINDER; Joseph P. Reed, Muncie, Ind. App. filed May 4, 1908. Patentee has a pair of arms fitted to the harp which can be moved into a vertical position to guide the wheel onto the wire.

897,410. CARBON-HOLDER; Oscar A. Ross, Chicago, Ill. App. filed July 30, 1906. A means by which the carbon must be secured within its holder before current will be conducted through it. Insures the carbons being properly forced into their holders.

897,413. SIGNALING CIRCUIT; Harry O. Rugh, Sandwich, Ill. App. filed May 2, 1908. Supervisory signaling circuits for use on telephone systems.

897,454. TELEGRAPHIC TRANSMITTER; George A. Cardwell, New York, N. Y. App. filed Aug. 19, 1905. A mechanical transmitter for attachment to a typewriter whereby the signals in any desired code, such as the Morse alphabet, may be automatically transmitted by the ordinary operations of manipulating the typewriter keys.

897,455. CLUSTER-FIXTURE FOR ELECTRIC LIGHTS; John H. Caldwell, Philadelphia, Pa. App. filed Dec. 21, 1907. A cluster socket having a porcelain casing and a porcelain interior base, the threaded shells and center contacts being screwed to the interior base.

897,457. HANGER FOR ELECTRIC LAMPS; George Cutter South Bend, Ind. App. filed June 6, 1906. Provides a single insulating means for adequately insulating high-voltage wires when attached to the hanger from overhead brackets or other supports.

897,466. SPARK-PLUG GUARD; Robert S. Kearney, New York, N. Y. App. filed April 9, 1907. Patentee has an insulated cup which fits over the exposed portion of an ordinary spark-plug.

897,472. JAR FOR STORAGE BATTERIES; Joseph Marx, Buffalo, N. Y. App. filed July 19, 1907. A storage battery jar having an outer and inner chamber both formed of rubber and joined by an annular rim with a soft rubber lip.

897,474. INDICATING FUSE PLUG AND HOLDER; Claude E. Montzer, Denver, Col. App. filed Feb. 19, 1906. A fuse cartridge having a spring disc at its end which is displaced when the fuse is blown.

897,475. ALTERNATING-CURRENT MOTOR; Maurice Milch, Schenectady, N. Y. App. filed Oct. 12, 1903. In an alternating-current motor, a primary member provided with a winding distributed over a portion only of the said member, a secondary member provided with a winding connected to the segments of a commutator, short-circuiting brushes on said commutator, a choke coil to the windings of which the said brushes are connected, and an auxiliary filed winding connected to middle points in the choke coil winding.

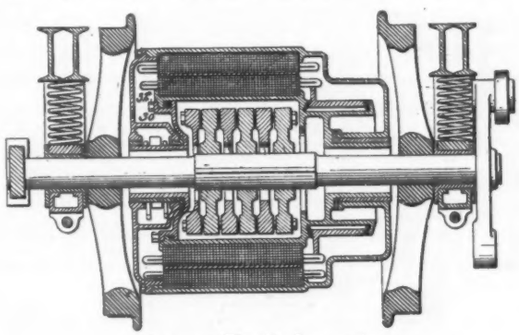
897,484. PNEUMATIC CONTROL SYSTEM; Philipp Pforr, Berlin Germany. App. filed April 19, 1907. Includes a reservoir-pipe for actuating the pneumatically operated devices on the cars. Has a manually controlled valve for varying the pressure in the reservoir-pipe and automatic valves for disconnecting the reservoirs from the reservoir-pipe when the pressure in the pipe falls below a predetermined limit.

897,492. ELECTRIC SWITCH; Oran O. Rider, Schenectady, N. Y. App. filed June 27, 1904. Has means for clutching the moving element of the switch to the operating lever so that the movement of the latter may be transmitted to the former, and a tripping mechanism actuated from a coil is provided to break the clutch connection upon the occurrence of predetermined electrical conditions.

897,497. STARTING AND SPEED-REGULATING RHEOSTAT; Frank J. Seabolt, Schenectady, N. Y. App. filed Jan. 25, 1908. Provides an electromagentic switch which always opens the circuit in addition to the controller arm, which may be left in any position.

897,500. CONDENSER; William B. Taylor, Lynn, Mass. App. filed Jan. 5, 1907. Construction of condenser having active plates of opposite polarity and terminal projections or ears on said plates, each of said plates being cut away at points adjacent to a terminal of opposite polarity.

897,501. SYSTEM OF ELECTRICAL DISTRIBUTION; Matthew O. Troy, Schenectady, N. Y. App. filed Nov. 11, 1905. A means for obtaining a high voltage direct constant current from a constant potential alternating-current system. Makes use of ordinary transformers of the constant potential type which are adapted to be more readily insulated for the high voltages than can transformers with relatively movable coils.



897,312.—Electric Locomotive.

897,507. SYNCHRONOUS MOTOR; Ernest F. W. Alexanderson, Schenectady, N. Y. App. filed May 5, 1905. In combination with a source of alternating current, a synchronous motor having a field provided with phase splitting means, means for connecting the field winding to said source and for short circuiting said armature winding to start the motor, and means for connecting said armature winding to said source and for supplying direct current to the field winding when the motor is up to speed.

897,508. ALTERNATING-CURRENT MOTOR; Ernest F. W. Alexanderson, Schenectady, N. Y. In an alternating-current motor, a laminated primary member, two primary windings of different pole members both carried on the same part of said member, two secondary windings of corresponding pole members, and connections whereby the current induced in one secondary winding may flow through the other.

897,514. LATCH MECHANISM; Paul Behr, Berlin, Germany. App. filed Jan. 23, 1907. A latch mechanism for circuit breakers adapted to secure a positive drop at a predetermined current, but avoid the wear which is incident to the impact of moving parts.

897,524. BLOCK-SIGNAL SYSTEM; Fred B. Corey, Schenectady, N. Y. App. filed Nov. 2, 1906. Provides a single relay adapted to take the place of a pair of relays which are employed in a previously patented installation in which alternating voltages and different frequencies are impressed at intervals on the track sections.

897,525. ELECTRIC SWITCH; Frank C. De Reamer, Schenectady, N. Y. App. filed Aug. 1, 1905. A form of knife-switch having spring clips to receive fuse cartridges in the place of the usual blades.

897,531. BLOCK-SIGNAL SYSTEM; Laurence A. Hawkins, Schenectady, N. Y. App. filed Feb. 19, 1908. Alternating-current block signal system in which an overlap is obtained. Is particularly adapted for trolley interurban roads in which abrupt stops are not objectionable. The signal circuit is applied near the centers of the blocks and the relay connections near the ends thereof.

897,536. MERCURY METER; Frank Holden, London, England. App. filed Jan. 30, 1907. A form of meter particularly adapted for use in connection with storage batteries to indicate the amount of charge and discharge. Has a mercury chamber with a piston adapted to be moved by the flow of mercury in the tube.

897,537. ELECTRIC CONTROLLING SYSTEM; John D. Ihlder, New York, N. Y. App. filed July 29, 1905. A means for automatically slowing down the speed of a car or carrier as it approaches its upper limit of travel and electrically holding the same at that point through the action of the electric motor connected to drive the hoisting apparatus.

897,538. SYSTEM OF MOTOR CONTROL; Leopold Janisch and William Naumann, Berlin, Germany. App. filed March 6, 1907. Has means operated by the controller of a series motor for connecting a resistance in parallel with the armature of the motor when the controller is moved even slightly toward its off position.

897,544. RECTIFIER SYSTEM; Osias O. Kruh, Schenectady, N. Y. App. filed Nov. 9, 1905. A rectifier system for high-voltage alternating current. Makes use of the ordinary mercury vapor bulbs grouped in a special way with a constant current transformer.

897,545. SINGLE-PHASE COMMUTATOR-MOTOR; Marius C. A. Latour, Paris, France. App. filed March 11, 1907. A single-phase motor of the commutator type having in combination with its main filed coils connections adapted to produce a relative phase displacement of the currents in the main field coils for adjacent poles whereby a commutating field is produced in the space between the adjacent sides of said coils.

897,548. ARC-LIGHT ELECTRODE AND METHOD OF MAKING THE SAME; Charles F. Lindsay, Schenectady, N. Y. App. filed Dec. 10, 1903. The method which consists in subjecting an electrode mixture to a chemical action to partially change it, forming electrodes out of the product, and thereafter continuing the chemical action to still further change the material.

897,559. SWITCH; Lawrence B. Stevnes, Rutherford, N. J. App. filed June 1, 1906. A switch designed for use in connection with any one of a series of batteries whereby they may be successively cut into and out of the electrical circuit, or connected up in parallel. Has concentrically arranged contacts engaged by a swinging arm.

897,564. PANEL-BOX; Frank S. Wahl, Olean, N. Y. App. filed April 29, 1907. A sheet metal panel-box having an inner and outer casing; the outer casing being used for the various circuit connections, and the inner casing containing snap switches and fuse blocks.

897,590. SUBSTATION-PROTECTOR; Frank B. Cook, Chicago, Ill. App. filed Nov. 8, 1907. Has a pair of cartridge fuses received between metallic clips and including branch connections to the carbon blocks of a lightning arrester enclosed in a cylindrical cup between the cartridge fuses.

897,602. CONTROLLER-REGULATOR; Frederick M. Du Bois, Syracuse, N. Y. App. filed Jan. 2, 1906. A means of preventing a too rapid movement of the controller handle. Includes a zig-zag groove into which a detent from the controller handle moves. The detent swings upward by centrifugal force and a pause must be made to allow it to swing inward to pass the successive notches.

897,607. AUTOMATIC CALLING-ON SIGNAL; William H. Elliott, New York, N. Y. App. filed Dec. 24, 1907. An interlocking block signal system, whereby a distinctive calling-on signal placed preferably at the entrance of the block section is adapted to operate when a train enters a section of track preceding the signal, and thus to give permission to the train to pass a home signal set at danger.

897,614. CLUSTER-LAMP SOCKET; Charles D. Gervin, New York, N. Y. App. filed Feb. 14, 1908. A cluster socket of the type having a hemispherical casing from which the lamps project radially outward. Includes a plurality of metallic parts which are electrically connected together by the engagement of a single terminal screw whereupon the lamps are arranged in multiple circuit, but, if desired, a series multiple arrangement may be made, or the lamps may be included in entirely separate circuits.

897,633. ELECTROLYTIC CELL; Gilbert C. Landis, York, Pa. App. filed July 2, 1907. A cell particularly designed for electrolytic solutions of chlorids for the production of chlorates. Is designed to circulate the solution.

897,657. ELECTRIC AND PNEUMATIC GOVERNOR; William K. Rankin, Philadelphia, Pa. App. filed Dec. 11, 1907. An electrically driven motor compressor of the accumulation of pneumatic pressure for the operation of brakes for railway cars. Has a diaphragm displaced by pneumatic pressure, and a rotatable disk which is clutched by the diaphragm into engagement with the rotating motor shaft, and which carries the switch contacts.

897,662. TELEGRAPHIC SELECTIVE SYSTEM; Alfred Moss Roberts, Buffalo, N. Y. App. filed Dec. 6, 1906. A telegraph system in which code signals are automatically switched or directed to a mechanism which causes a printing or recording of the particular letter corresponding to the code signal. Is a multiplication of a quadruplex telegraph system.

897,667. TROLLEY-WHEEL; Edward P. Sharp, Buffalo, N. Y. App. filed Dec. 26, 1905. The trolley-wheel is made of two disks and a central tread which are renewable and clamped together by flanges forming part of the hub.

897,669. INSULATOR; Frank Joseph Siegwart, Pittsburg, Pa. App. filed Jan. 3, 1908. An insulator with a diagonal groove communicating with a circumferential groove, the conductor being passed around the insulator in an "S"-shaped form.

897,674. TERMINAL FOR ELECTRIC FITTINGS; Frederick A. Swan, Cliftondale, Mass. App. filed April 26, 1907. In an electrical fitting, the combination with a terminal of conducting material, of means to detachably connect a conducting wire thereto, said terminal having integral therewith means to relieve said conducting means from any strain to which the wire may be subjected.

897,681. TELEPHONE SWITCH; Clarence Truitt, Moscow, Idaho. App. filed June 8, 1907. The combination with a telephone in a party line circuit of a switch bar pivoted directly above its receiver-hook and normally arranged in a vertical position with its free end engaging said hook, means to turn said switch bar to permit said hook to rise, and means to break the main line circuit when said switch is turned.

897,683. CONDUIT-CAP FOR ELECTRIC INSTALLATION; Wheeler H. Vibber, New London, Conn. App. filed Feb. 6, 1908. The conduit pipe terminates in a box having specially formed bushings by which a water-tight connection is made for all the entering conduits and cables.

897,692. ELECTRIC ORGAN-ACTION; William R. Whitehorne, Brooklyn, N. Y. App. filed May 16, 1907. An electric apparatus for controlling the operation of an organ having an independent valve controlling magnet for each organ pipe, the supply of the current being controlled by the keys and stops of the organ.

897,696. AIR-BRAKE VALVE; David S. Sffleck, Chicago, Ill. App. filed Dec. 5, 1907. Has signal and safety appliances normally held in running position by means of a magnet included in a circuit which may either be opened or closed under abnormal conditions to affect the automatic actuation of the air brakes in case the usual semaphore signal is disregarded.

897,700. INSULATING COUPLING; Homber Ashbaugh, Indianapolis, Ind. App. filed March 7, 1908. An insulating coupling comprising members permanently connected together and electrically isolated, one of which is arranged eccentrically relative to the other and is also arranged to be adjusted with respect to the longitudinal center of such other without disturbing the permanent connection of the members or the electrical isolation of the same.

897,702. ELECTRIC SIGNAL SYSTEM; Anthony A. Barbera, Philadelphia, Pa. App. filed Feb. 28, 1908. A cap signal system making use of a plurality of contacts mounted on bases adjacent to the trackway and which are engaged by approaches directed laterally from the locomotive.

897,713. MOTOR-STARTER; Anthony J. Burns, Otsego, N. Y. App. filed Aug. 9, 1907. A motor starter of the automatic or no-voltage release type, designed primarily for alternating-current motors of any phase, size or type, whereby the resistances in series with the motor can be gradually cut out of circuit during starting, but the same circuit automatically opened by failure of current.

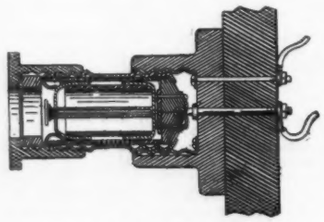
897,716. TRANSMITTER; Jesse T. Curtis, Bement, Ill. App. filed March 25, 1907. In a transmitter, the combination of a vibratory diaphragm provided with a sunken portion in which is mounted a cup, a second diaphragm engaging said sunken portion and also engaging said cup, an electrode secured to the central portion of said second diaphragm and having a threaded stem passing through an opening in the said sunken portion of said vibratory diaphragm.

897,718. TELEPHONE INSTRUMENT; Wilford R. Daniels, New York, N. Y. App. filed April 10, 1908. In a telephone instrument the combination of a sound receptacle, a solid body conforming to the flaring shape of the exterior of the ear-piece of the telephone receiver for collecting the sound produced in the said receiver.

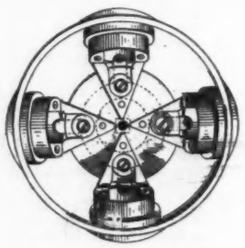
897,723. TELEPHONE SYSTEM; William W. Dean, Chicago, Ill. App. filed Jan. 22, 1904. Complete cord, battery and signal circuits of exchange system.

897,731. SIGNALING DEVICE FOR TELEPHONE-EXCHANGES Thomas W. Gardner, Nashville, Tenn. App. filed Feb. 15, 1905. A telephone system including a source of electrical energy, a central exchange, an operator's set, two balanced windings having a common core, a condenser in series with the operator's head receiver, and connections between said apparatus such that the condenser is maintained in a charged condition by the battery and said windings.

897,766. ELECTRIC CIGAR-LIGHTER; Ernest P. Muller, Brooklyn, N. Y. App. filed Feb. 4, 1907. Has a pair of torches which dip into a fuel reservoir and which can be removed and put in contact with a gap forming the terminals of a circuit so as to ignite the wick.



897,474.—Inducting Fuse Plug and Holder.



897,614.—Cluster Lamp Socket.

897,779. RECEIVER FOR WIRELESS SIGNALING; Valdemar Poulsen, Copenhagen, Denmark. App. filed March 6, 1907. The method of wireless signaling which consists in impelling the energy from a resonant oscillation circuit having inductance and capacity through a detector having inductance by periodically unbalancing or destroying the condition of resonance in said circuit.

897,782. HEATER FOR APPLYING AND MELTING WAXES, PARAFFINS, SOLDERS AND SIMILAR SUBSTANCES; Frank A. Reilley, Port Chester, N. Y. App. filed July 17, 1907. Has a conical vat wrapped with a double-wound resistance. Includes a ball valve at the bottom to permit the fluid to pass out.

897,800. LIGHTNING ARRESTER; Charles P. Steinmetz, Schenectady, N. Y. App. filed Dec. 28, 1900. In a lightning arrester, the combination of spark gap terminals, and a resistance in circuit therewith formed essentially of an oxid the resistance of which decreases when heated.

897,805. INCANDESCENT-LAMP SOCKET; William F. Wegner, New York, N. Y. App. filed Aug. 20, 1907. A lamp receptacle having a two-part base and two metallic elements which constitute the terminals, and the shell and center contacts, respectively. The threads for the lamp base are formed partly by grooves in the porcelain and partly by corrugation in one of the metallic clips.

897,812. INVERSE TIME-LIMIT RELAY; Peter Bendmann, Berlin, Germany. App. filed Jan. 18, 1907. A lever is resisted in its movement toward an electromagnet by a gear motion connected with a reciprocating piston movement so as to insure a slow movement of the lever toward attracted position.

897,824. POLE-SHOE; William R. Everett and Edwin J. Newton, Chicago, Ill. App. filed Aug. 17, 1904. Details of the field construction of a motor having the pole-shoes formed with overlapping extensions.

897,833. REVERSIBLE GALVANIC BATTERY; Harry C. Hubbell, Orange, N. J. App. filed June 2, 1906. A plate for reversal batteries comprising a dry-pressed tablet of powdered nickel hydrate and powdered oxid of silver.

897,852. SAFETY-FUSE; Joseph Sachs, Hartford, Conn. App. filed May 18, 1907. Has a plurality of separately insulated and sheathed conductors, connected in multiple to common electrodes, and means for effecting a tension to separate the said conductors immediately upon the same becoming disrupted.

897,858. AUTOMATIC CIRCUIT-BREAKER; Henry Price Ball, New York, N. Y. App. filed Jan. 31, 1903. Circuit-breaker of the type adapted to be used in connection with an oil switch and to be actuated by an overload in the circuit; has a double-throw switch biased to open when closed and having its open position between two closed positions.